JB
11-21-66

MODEL DY-2901
INPUT SCANNER
Serials prefixed 244-

MODEL DY-2902/3/4
INPUT SCANNER
Serials prefixed 251-

OPERATING AND SERVICE MANUAL

HEWLETT hp PACKARD

HANDBOOK

for

MODEL DY-2901
INPUT SCANNER
Serials prefixed 244-

MODEL DY-2902/3/4
INPUT SCANNER
Serials prefixed 251-

INTRODUCTION

Model DY-2901 Input Scanners, serials prefixed 244 and Model DY-2902/3/4 Input Scanners, serials prefixed 251 incorporate several design changes resulting in improved operation.

In addition the specifications for the upper limit of the signal circuit voltage range and the measurement delays are changed. The upper limit of the signal circuit voltage range is raised to 500 volts rms, 750 volts peak; the measurement delays are changed to 25, 50, 120, or 910 ms (approx.).

The General Description and Installation & Operation instructions in the accompanying handbook apply except as follows:

a) The measurement delays and upper limit of the signal circuit voltage range are changed as previously described.

b) The wiring of several connectors has been changed to provide more flexibility in interconnection of the Scanner within systems. These changes are described in the following section.

CONNECTOR FUNCTIONS

The connector functions as described in Section 2.1 and Tables 4.1 through 4.7 in the accompanying DY-2901/2/3/4 Input Scanner handbook are changed as follows:

a) The "ohms" delayed output connector, J-113 is changed to a five pin connector, XLR-5-32. This change provides for compatability with a DY-2410A AC/OHMS Converter.

b) The following lists changes to connectors J101, J103, J104, J201, J202, J203 and J204 (Tables 4.1 through 4.7 in the accompanying handbook).

CHANGES TO CONNECTORS

DY-2901 INPUT SCANNER, Serials Prefixed 244-
DY-2902/3/4 INPUT SCANNERS, Serials Prefixed 251-

TABLE 4.1 J101 PIN CONNECTIONS

J101 PIN	CHANGE DESCRIPTION TO	CHANGE INTERNAL DESTINATION TO
A	Routes section A program common to K1J arm in DY-2902 when DY-2901 is in "Home" position.	K1J position 26
T	25 ms time delay from DY-2902/3/4	R234
U	50 ms time delay from DY-2902/3/4	R233
V	120 ms time delay from DY-2902/3/4	R232
c	Output pulse initiated at termination of time delay multivibrator (coupled through Q208). Used to gate a DY-2401A Integrating Digital Voltmeter or equivalent.	R230
m	Channel advance pulse	J104-m

TABLE 4.1 J101 PIN CONNECTIONS (Cont'd)

J101 PIN	CHANGE DESCRIPTION TO	CHANGE INTERNAL DESTINATION TO
d	Spare	(Spare)
m	Channel advance pulse for CONTINUOUS or SINGLE SCAN mode.	S202B, pos 4 & 5
n	Output pulse initiated at termination of time delay multivibrator. Used for overload reset for DY-2401A Integrating Digital Voltmeter or equivalent.	

TABLE 4.2 J103 PIN CONNECTIONS

J103 PIN	CHANGE DESCRIPTION TO	CHANGE INTERNAL DESTINATION TO
e	-26 vdc from DY-2902 when DY-2901 is at position 25.	CR3
f	No change	A1(22)
g	-26 vdc when DY-2901 is at position 25.	K1E position 25

NOTE: Pins e and g must be jumpered in the last Scanner used in the series.

TABLE 4.3 J104 PIN CONNECTIONS

J104 PIN		
b	Program Board Row A15 output	PB, Row A15

TABLE 4.4 J201 PIN CONNECTIONS

J201 PIN	CHANGE DESCRIPTION TO	CHANGE INTERNAL DESTINATION TO
T	25 ms time delay from DY-2903/4	no change
U	50 ms time delay from DY-2903/4	no change
V	120 ms time delay from DY-2903/4	no change
c	Routes gating pulse for DY-2401A Integrating Digital Voltmeter.	J-202c
d	Spare	J202d
m	Channel advance pulse	J-202m
n	Routes output pulse for overload reset of DY-2401A.	J-202n

TABLE 4.5 J202 PIN CONNECTIONS

J202 PIN		
T	25 ms time delay to DY-2901 from DY-2902/3/4	J-201T & P.B., row B1
U	50 ms time delay to DY-2901 from DY-2902/3/4	J-201U & P.B., row B1
V	120 ms time delay to DY-2901 from DY-2902/3/4	J-201V & P.B., row B1
c	DY-2401A gating pulse	J-201c
d	Spare	J-201d
m	Channel advance pulse	J-201m
n	Overload reset for DY-2401A	J-201n

TABLE 4.6 J203 PIN CONNECTIONS

J203 PINS	CHANGE DESCRIPTION TO	CHANGE INTERNAL DESTINATION TO
e	-26vdc from DY-2903 when DY-2902 is at position 25 (channel 50)	J204e
g	-26 vdc when DY-2902 is at position 25 (channel 50). NOTE: Pins e and g must be jumpered in the last Scanner used in the series.	J204g

TABLE 4.7 J204 PIN CONNECTIONS

J204 PINS		
e	-26vdc to DY-2901 when DY-2901 is in position 25 & DY-2902 stepping switch coil energized.	K-1A N.O.
g	-26vdc from DY-2901 when DY-2901 is at position 25 (channel 25)	K-1A Arm

THEORY OF OPERATION

Referring to drawings C2901-1049, D2901-1048 and Figure 4.8 in the accompanying handbook, the bi-stable multivibrator (Q202 and Q203) and the relay circuits, K201 and K2, have been removed. These changes also remove relay K2 from the DY-2902/3/4 stepper control circuit, as shown on drawing A2902-1011. In place of the multivibrator a silicon controlled rectifier circuit (SCR201) is used. The silicon controlled rectifier is a 3-terminal, bi-stable device that can carry a relatively large current. The rectifier is turned on by a positive going pulse applied to its "grid," and can only be turned off by interrupting its holding current. (In this respect, a silicon controlled rectifier acts like a conventional thyratron).

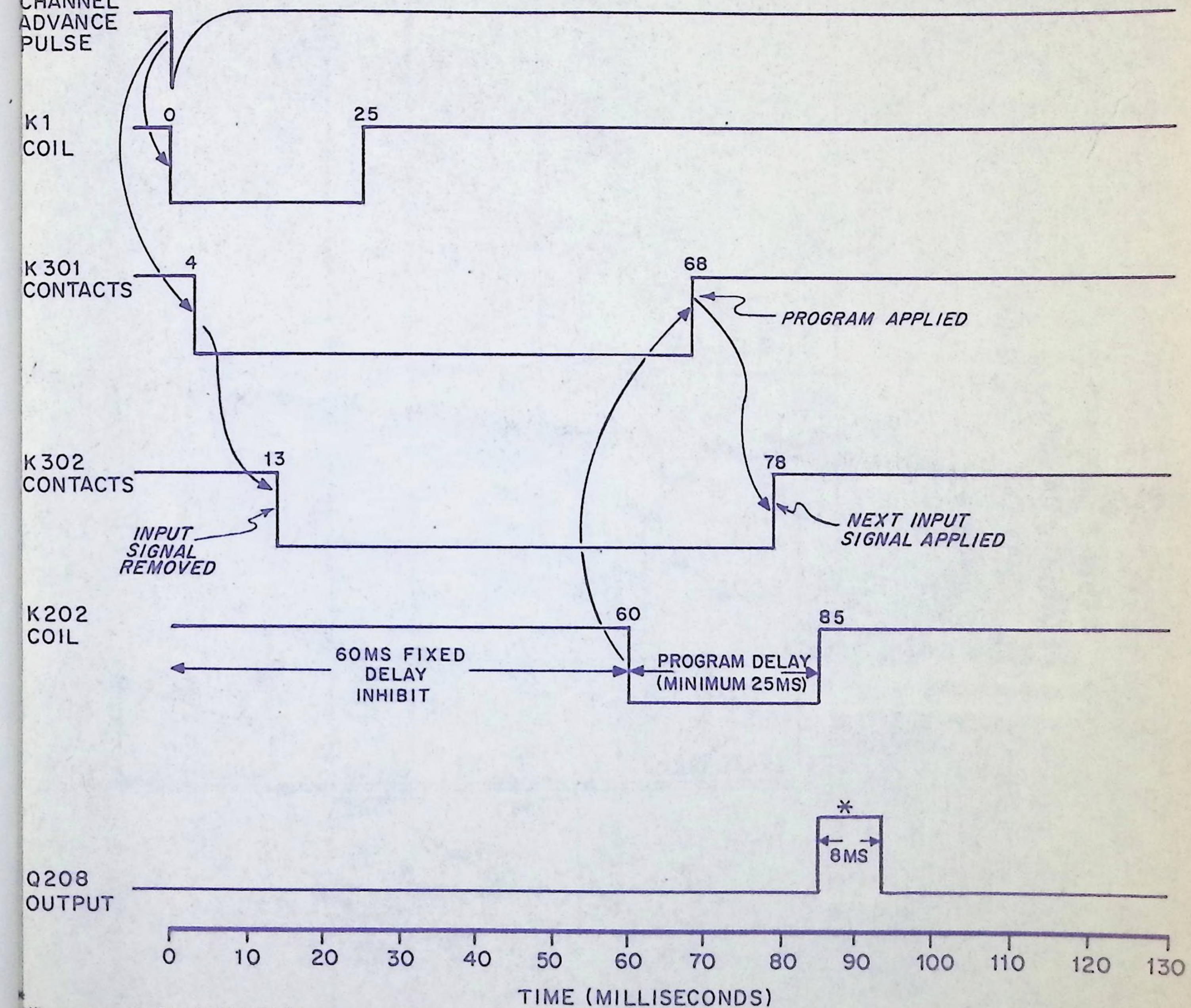
In the DY-2901 operation, a negative-going channel advance pulse is amplified and inverted by Q201. The amplified and inverted channel advance pulse is coupled to the silicon controlled rectifier SCR 201, turning it on. When SCR 201 turns on, stepping switch K1 coil is energized via the K1A off-normal contacts. At the same time relay K301 is energized via the K301D contacts. The ground return for K301 is via the K202B normally closed contacts. In addition the K202B normally closed contacts connect chassis ground to pin n of J104.

The output of Q201 is also coupled to the 60 ms one-shot multivibrator OS1 (Q202 and Q203). The amplified and inverted channel advance pulse causes the OS1 to switch to its unstable state, biasing Q204 into conduction. After approximately 25 ms, K1 de-energizes and the stepping switch steps to the next position. However the -26vdc from the measure bus (assuming the channel selection switch is set for a data measurement) does not change the one-shot multivibrator OS2(Q206 and Q207) to its unstable state until OS1 returns to its stable state. This action is caused by the conduction of Q204 during OS1 on time, causing the -26 vdc to be dropped across R207. (This prevents double triggering of OS2 due to contact bounce of the stepping switch.) Thus 60 ms after the channel advance pulse is applied to Q201, OS2 changes to its unstable state, which energizes relay K202. When relay K202 energizes, its B contacts close to the normally-open side and the ground return for K301 is removed. Removing the ground from K301 causes K301 to de-energize and the holding current for SCR201 to be interrupted. Thus, SCR 201 turns off and awaits the next channel advance signal.

Relay K202 remains energized while OS2 is in its unstable state. The time OS2 remains in its unstable state is determined by the programmed measurement delay. When OS2 switches to its stable state, a negative going pulse is applied to the base of Q208. The output of Q208 is routed to J104 pin p and J101 pins n and c. This output pulse may be used as a gating and overload reset pulse for a DY-2401A Integrating Digital Voltmeter, or similar instrument.

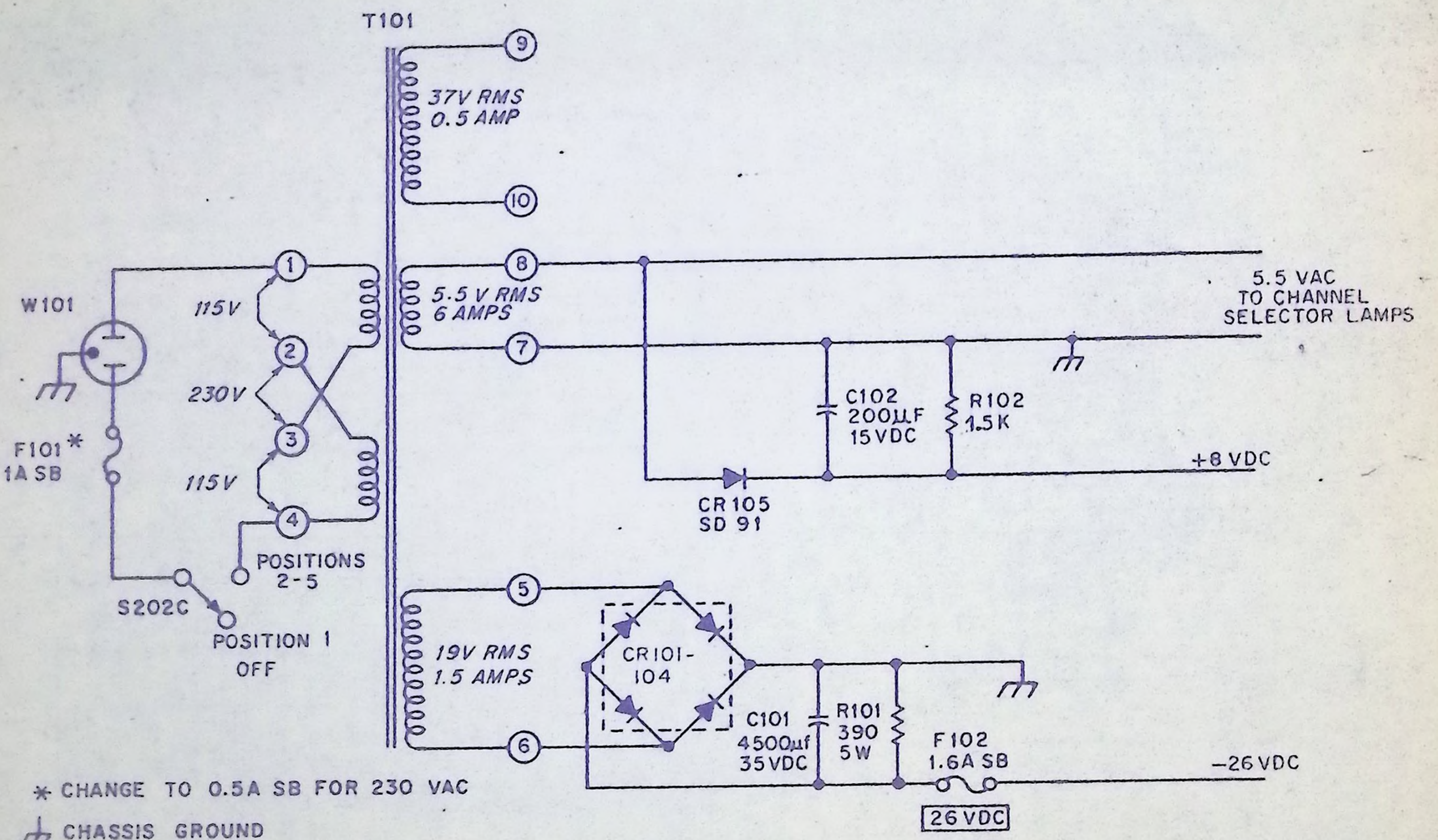
The stepping switch circuits for the DY-2901 and DY-2902 have been changed as shown on drawings D2901-1042 and D2902-1010 respectively. When the DY-2901 stepping switch steps to its last channel position (25), -26 vdc is routed via J-103 g to J-204 g on the DY-2902. The DY-2902 stepping switch coil (K1) is then energized through the section A interrupter contacts. Energizing K1 in the DY-2902 causes the -26 vdc to be routed back to the DY-2901 via J-204e and J-103e to the last channel position. Assuming the channel selection switch for that channel is in the measure position, the -26 vdc is routed to OS2 as previously described. When the DY-2901 steps to position 26 (home), the -26 vdc is disconnected from the stepping switch coil (K1) in the DY-2902. The DY-2902 then steps to its first channel position (channel 26). The DY-2902 then continues the scanning cycle. On the DY-2902 last channel position (channel 50), the -26 vdc on its stepping arm is routed to the 25th switch arm via the DY-2903. This action is similar to the routing of the -26 vdc via the DY-2902 when the DY-2901 has reached its last channel position. If the DY-2902 is the last in the series of Input Scanners, the -26 vdc is routed to the DY-2902 25th switch arm via a jumper between pins e and g on the interlock connector for J-203.

As previously described, relay K-301 (drawing C2901-1041) is energized when SCR201 is turned on by a channel advance pulse. When relay K301 energizes it self-latches through its section D contacts. Diode CR301 maintains the relay coil current while the section D contacts are switching. Section A contacts of relay K301 energize relay K302. While K302 is energized the K1 stepping switch arms for levels A and B are disconnected from the output circuits. Relay K301 is de-energized when relay K202 is energized by OS2 switching to its unstable state. Thus relay K302 is de-energized. At this point the new channel is connected to the measuring equipment as determined by the programming of relay K303 and K304. However a measurement does not occur until the end of the measurement delay period, since the gating pulse (via Q208) occurs at the end of the measurement delay period.



* When used with DY-2410A AC/Ohms Converter and DY-2401A Digital Voltmeter combination for AC voltage or ohms measurements, the DY-2401A provides additional measurement delays (see DY-2401A handbook). These delays occur after the 8ms gating pulse (Q208 output).

DY-2901
INPUT SCANNER
TYPE 244
TIMING DIAGRAM



* CHANGE TO 0.5A SB FOR 230 VAC

⏚ CHASSIS GROUND

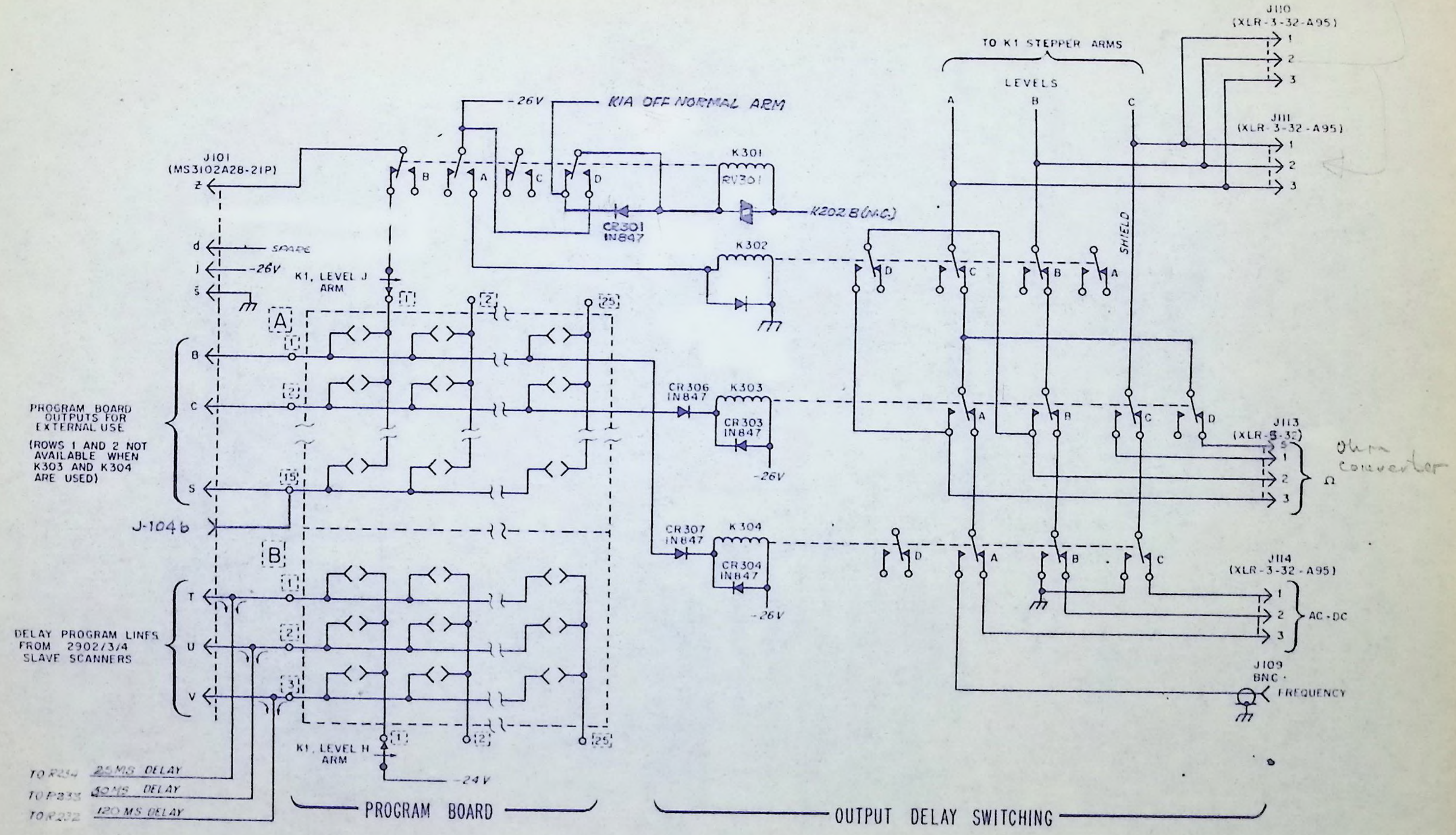
⏚ CIRCUIT GROUND

FIGURE 4.6

DY-2901 INPUT SCANNER

POWER SUPPLY

SERIALS PREFIXED 24-4



NOTE:

⏚ = CHASSIS GROUND

⏊ = CIRCUIT COMMON

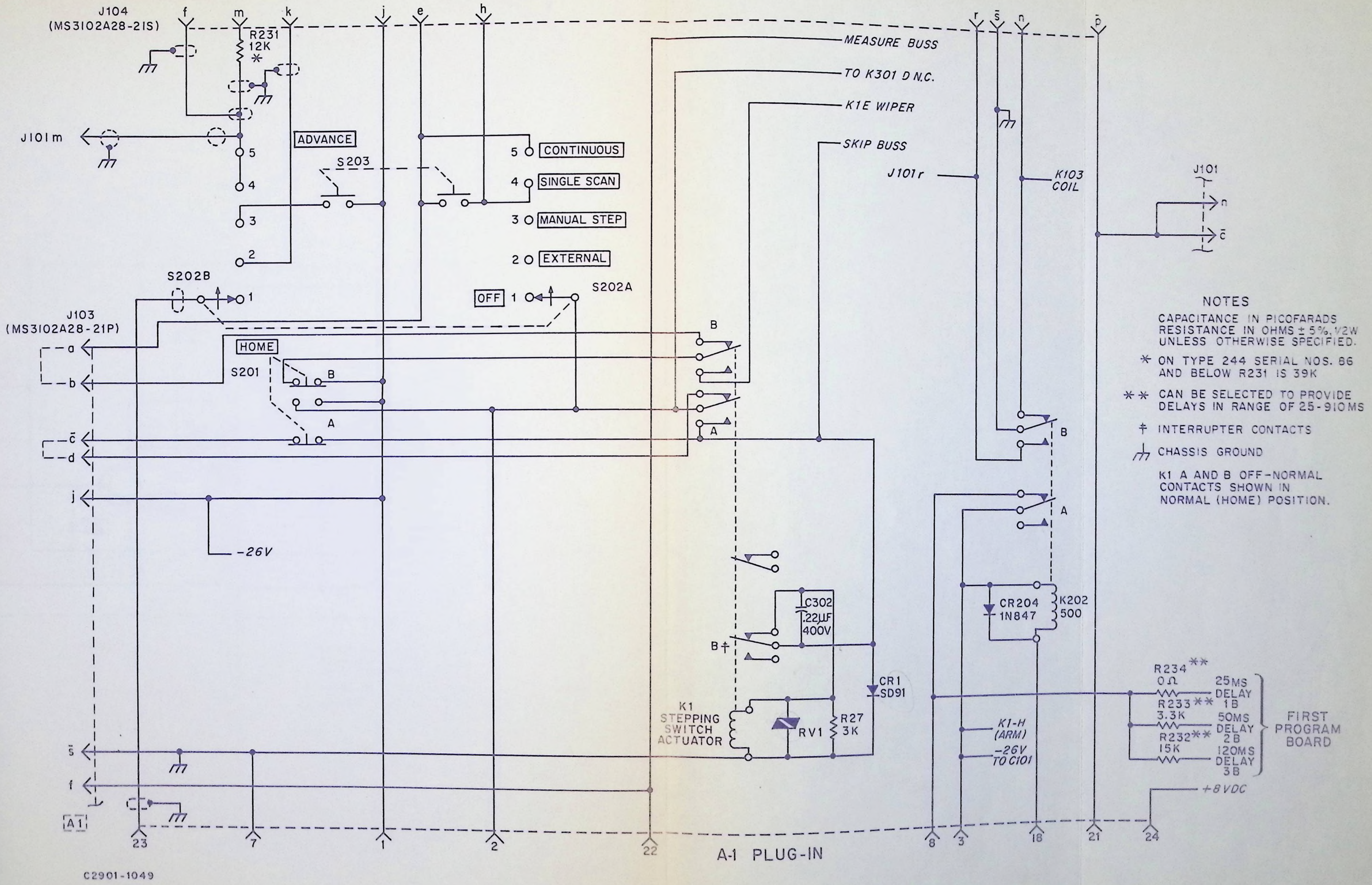
FIGURE 4.7

MODEL DY-2901 INPUT SCANNER

OUTPUT DELAY SWITCHING AND PROGRAMMING BOARD SECTION

SERIALS PREFIXED 244

C2901-1094



NOTES

CAPACITANCE IN PICOFARADS
RESISTANCE IN OHMS ± 5%, 1/2W
UNLESS OTHERWISE SPECIFIED.

* ON TYPE 244 SERIAL NOS. 86 AND BELOW R231 IS 39K

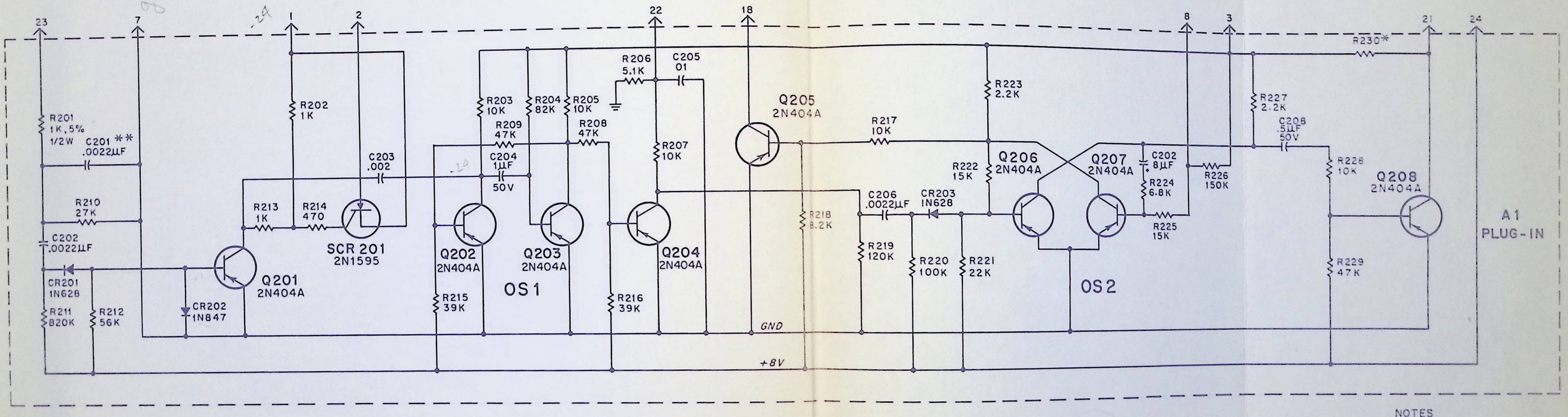
** CAN BE SELECTED TO PROVIDE DELAYS IN RANGE OF 25-910MS

† INTERRUPTER CONTACTS

⏚ CHASSIS GROUND

K1 A AND B OFF-NORMAL CONTACTS SHOWN IN NORMAL (HOME) POSITION.

DY-2901 INPUT SCANNER
CONTROL & INPUT CIRCUITS
SERIALS PREFIXED 244-



D2901-1048

NOTES

CAPACITANCE IN PICOFARADS.
RESISTANCE IN OHMS, ± 5%, 1/2W
UNLESS OTHERWISE SPECIFIED.

* VALUE SELECTED AT FACTORY.

** SUBJECT TO REMOVAL IN CERTAIN SYSTEMS.

DY-2901 INPUT SCANNER

CONTROL CIRCUIT A1

SERIALS PREFIXED 244-

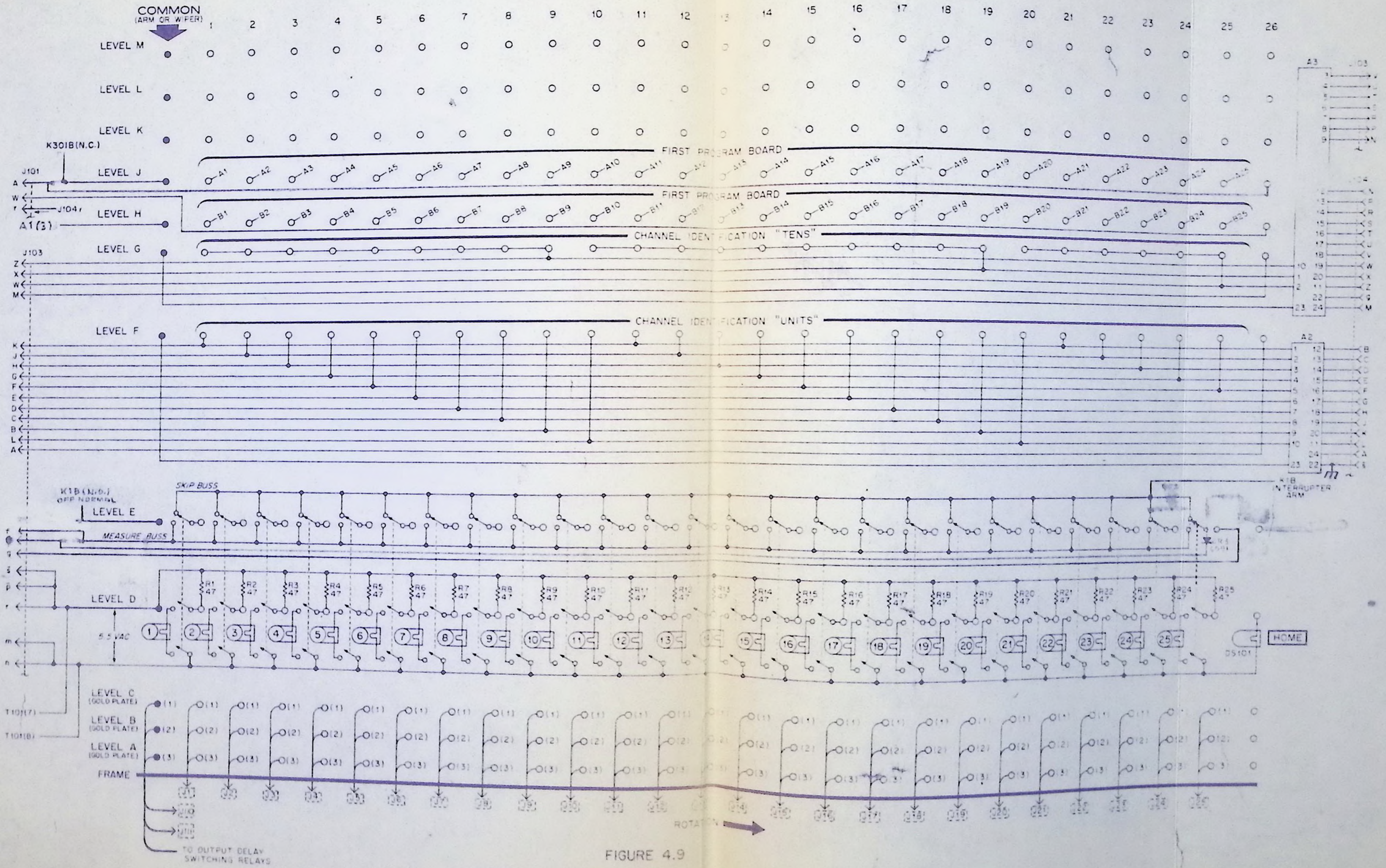


FIGURE 4.9

MODEL DY-2901 INPUT SCANNER

STEPPING SWITCH CIRCUITS

SERIALS PREFIXED 244

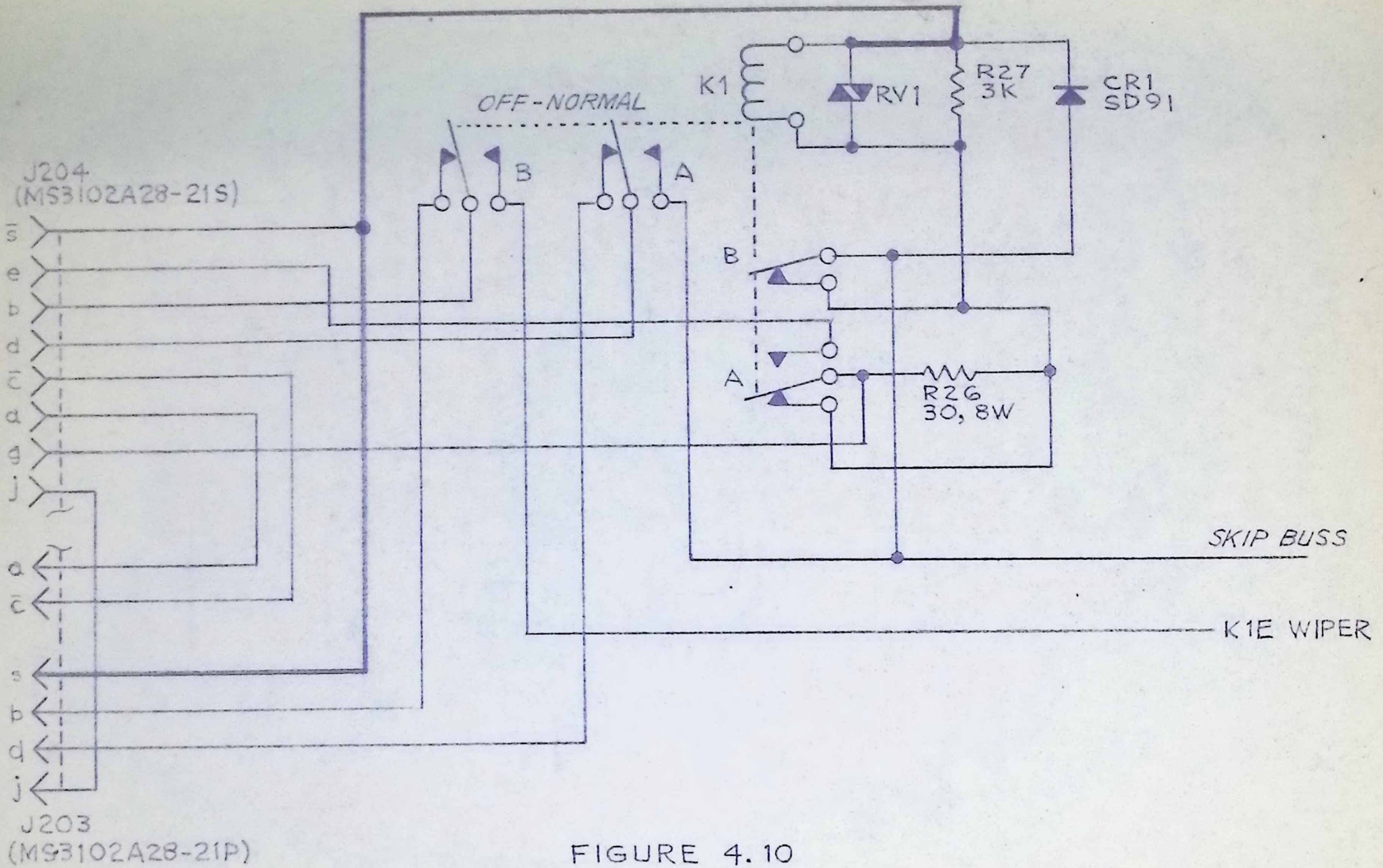


FIGURE 4.10

DY-2902/3/4 INPUT SCANNER
STEPPER CONTROL CIRCUIT
SERIALS PREFIXED 251

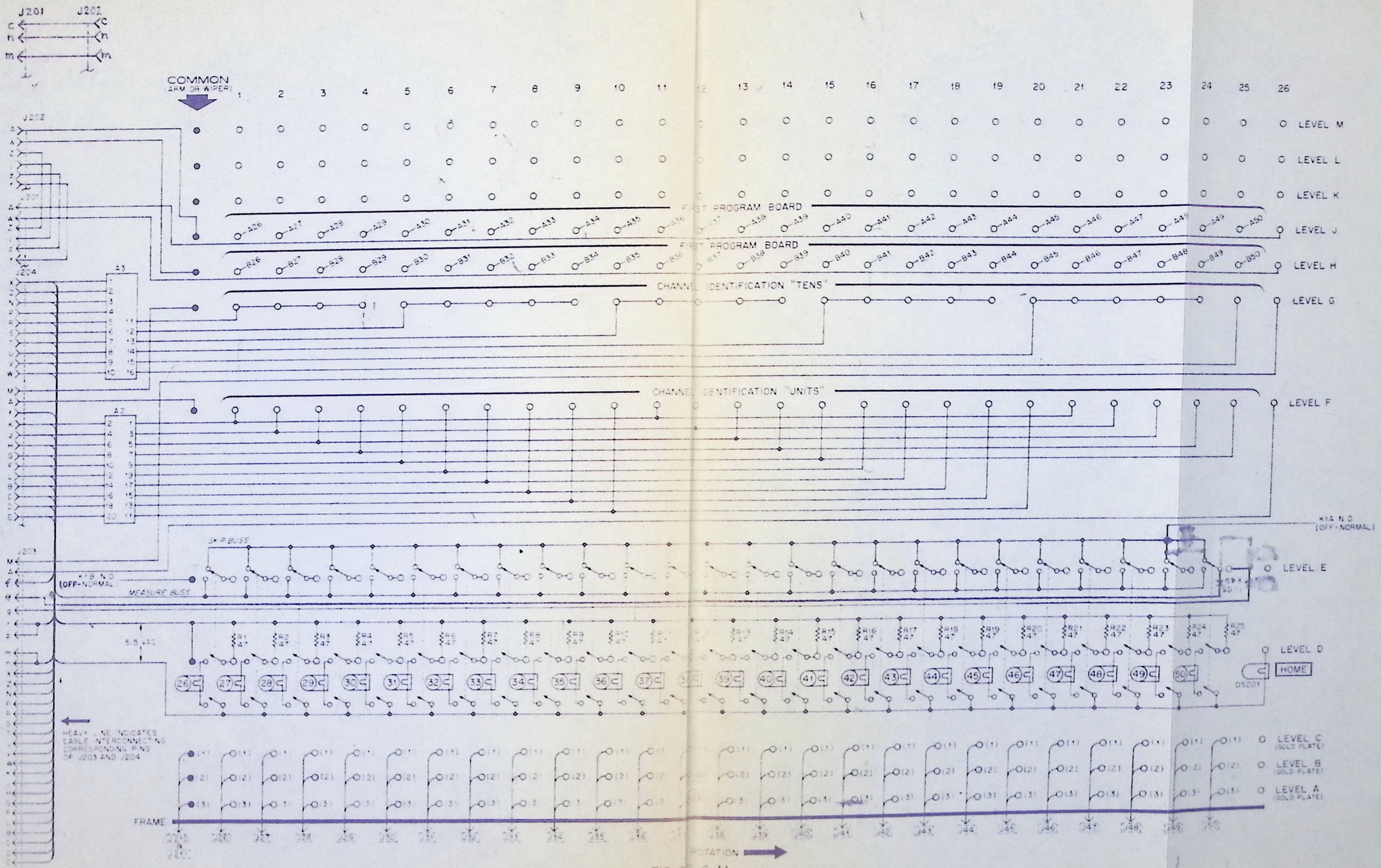


FIGURE 4.11

MODEL DY-2902/3/4 INPUT SCANNERS

STEPPING SWITCH CIRCUITS

SERIALS PREFIXED 251

[illegible] 1010

REFERENCE DESIGNATOR	DESCRIPTION	DYMEC STOCK NO.	*MFR. CODE	MFR. PART NO.	QTY.	†1-YR. SPA.
C101	Capacitor: fixed, electrolytic, 4500uf, 35V	1010-0030	56289	32D314	1	1
C102	Capacitor: fixed, electrolytic, 200uf, 15V	1010-0022	56289	TE1164	1	1
C201-3, 6	Capacitor: fixed. Mylar, .0022uf, 10%, 200V	1008-0052	56289	192P22292	4	1
C204	Capacitor: fixed, metallized paper, 1uf, 50V, 10%	1007-0046	Westcap	WS4K105	1	1
C205	Capacitor: fixed, Mylar, .01uf, 10%, 200V,	1008-0060	56289	192P10392	1	1
C207	Capacitor: fixed, electrolytic, 8uf, -15 +20%, 30V	1011-0002	21520	PP8B30A1	1	1
C208	Capacitor: fixed, metallized paper, 20%, .5uf, 20%, 50V	1007-0047	02777	P5P5D	1	1
CR3, 105-109	Diode, silicon, SD-91	1281-0013	81483		6	6

* Manufacturers' codes on last page. † Recommended 1-year isolated-use spares per MIL-E-17362A.

REFERENCE DESIGNATOR	DESCRIPTION	DYMEC STOCK NO.	*MFR. CODE	MFR. PART NO.	QTY.	†1-YR SPA.		
CR101-104	Rectifier, germanium	1297-0011	24446	4JA211FB 1AC1	1	1		
CR202, 301-304, 306-307	Diode, silicon: 1N847	1281-0031	73293		7	7		
DS101	Lamp, incandescent, 6V	2870-0012	71744	Type 345	1	1		
	Lampholder for above	2900-0013	72619	137-8536-9	1	1		
	Lens for above	2925-0004	72619	137-931	1	1		
F101	Fuse, 1 amp, Slo Blo	1955-0002	71400	MDL-1	1	10		
F102	Fuse, 1.6 amp, Slo Blo	1955-0012	71400	MDL-1.6	1	10		
	Fuseholders for above	1965-0001	75915	342012	2	1		
J1-25, 110, 111, 114	Receptacle, 3 pin, male: XLR-3-32-A95	2535-0056	71468		28	5		
J101, 103	Receptacle, 37 pin, male: MS3102A28-21P	2538-0003	71468		2	1		
J104	Receptacle, 37 pin, female: MS3102A28-21S	2537-0003	71468		1	1		
J109	Receptacle, female, BNC	2536-0003	91737	1094/U	1	1		
J113	Receptacle, 5 pin, male, XLR-5-32	2535-0095	71468		1	1		

* Manufacturers' codes on last page. † Recommended 1-year isolated-use spares per MIL-E-17362A.

REFERENCE DESIGNATOR	DESCRIPTION	DYMEC STOCK NO.	MFR. CODE	MFR. PART NO.	QTY.	SPA.
K1	Switch, stepping, type 45, 24V NOTE: Replace 48V coil with a 24V coil	1311-0037	04777	PW-12250-1		1
K202	Relay, 500 ohm coil, 2 form C	1311-0039	04777	EQA type PE-402-B17	1	1
K301-304	Relay, 4 form C, 24V	1311-0040	77342	KHP-17D11	1	1
P1-25, 111, 114	Connector, 3 pin, female: XLR-3-11C-A95 (Mating connector for J1-25)	2535-0057	71468		28	6
P101	Connector, 37 pin, female: MS3106B28-21S (Mating Connector for J101)	2539-0003	71468		1	1
P103	Connector, 37 pin, female: pins A and B jumpered, and pins C and D jumpered: MS3106B28-21S (Mating connector for J103)	A2901-3046	04404		1	1
P104	Connector, 37 pin, male: MS3106B28-21P (Mating connector for J104)	2540-0002	71468		1	1
P113	Connector, 5 pin, female XLR-5-11C	2535-0092	71468		1	1

* Manufacturers' codes on last page. † Recommended 1-year isolated-use spares per MIL-E-17362A.

REFERENCE DESIGNATOR	DESCRIPTION	DYMEC STOCK NO.	*MFR. CODE	MFR. PART NO.	QTY.	†1-YR. SPA.		
R203, 205, 207, 217, 228	Resistor: fixed, composition, 10K, 5%, 1/2W	1067-1035	01121	EB1035	5	2		
R204	Resistor: fixed, composition, 82K, 5%, 1/2W	1067-8235	01121	EB8235	1	1		
R206	Resistor: fixed, composition, 5.1K, 5%, 1/2W	1067-5125	01121	EB5125	1	1		
R208, 209, 229	Resistor: fixed, composition, 47K, 5%, 1/2W	1067-4735	01121	EB4735	3	1		
R210	Resistor: fixed, composition, 27K, 5%, 1/2W	1067-2735	01121	EB-2735	1	1		
R211	Resistor: fixed, composition, 820K 5%, 1/2W	1067-8235	01121	EB8235	1	1		
R212	Resistor: fixed, composition, 56K, 5%, 1/2W	1067-5635	01121	EB5635	1	1		

* Manufacturers' codes on last page. † Recommended 1-year isolated-use spares per MIL-E-17362A.

REFERENCE DESIGNATOR	DESCRIPTION	DYMEC STOCK NO.	*MFR. CODE	MFR. PART NO.	QTY.	†1-YR. SPA.		
Q201-208	Transistor, germanium: 2N404A	1271-0023	72699		8	2		
R1-25	Resistor: fixed, composition, 47 ohms, 5%, 1/2W	1067-4705	01121	EB4705	25	6		
R26	Resistor: fixed, wirewound, 30 ohms, 5% 8W	1160-0007	94310		1	1		
R27, 214	Resistor: fixed, composition, 470 ohms, 5%, 2W	1069-4715	01121	HB4715	2	1		
R28	Resistor: fixed, composition, 4.7K, 5%, 1/2W	1067-4725	01121	EB4725	1	1		
R101	Resistor: fixed, wirewound, 390 ohms, 1%, 5W	1160-0011	91637	Type RS-5	1	1		
R102	Resistor: fixed, composition, 1.5K, 5%, 1/2W	1067-1525	01121	EB1525	1	1		
R201, 202, 213	Resistor: fixed, composition, 1K, 5%, 1/2W	1067-1025	01121	EB1025	3	1		

* Manufacturers' codes on last page. † Recommended 1-year isolated-use spares per MIL-E-17362A.

REFERENCE DESIGNATOR	DESCRIPTION	DYMEC STOCK NO.	*MFR. CODE	MFR. PART NO.	QTY.	†1-YR. SPA.		
R213	Resistor: fixed, composition, 1K, 5%, 1/2W	1067-1025	01121	EB1025	1	1		
R215, 216	Resistor: fixed, composition, 39K, 5%, 1/2W	1067-3935	01121	EB3935	2	1		
R217	Resistor: fixed, composition, 10K, 5%, 1/2W	1067-1035	01121	EB1035	1	1		
R218	Resistor: fixed, composition, 8.2K, 5%, 1/2W	1067-8225	01121	EB8225	1	1		
R219	Resistor: fixed, composition, 120K, 5%, 1/2W	1067-1245	01121	EB1245	1	1		
R220	Resistor: fixed, composition, 100K, 5%, 1/2W	1067-1015	01121	EB1015	1	1		
R221	Resistor: fixed, composition, 22K, 5%, 1/2W	1067-2235	01121	EB2235	1	1		

* Manufacturers' codes on last page. † Recommended 1-year isolated-use spares per MIL-E-17362A.

REFERENCE DESIGNATOR	DESCRIPTION	DYMEC STOCK NO.	* MFR. CODE	MFR. PART NO.	QTY.	† 1-YR. SPA.		
R222, 225, 232	Resistor: fixed, composition, 15K, 5%, 1/2W	1067-1535	01121	EB1535	3	1		
R223, 227	Resistor; fixed, composition, 2.2K, 5%, 1/2W	1067-2225	01121	EB2225	2	1		
R226	Resistor: fixed, composition, 150K, 5%, 1/2W	1067-1545	01121	EB1545	1	1		
R230	(Value selected)							
R231	Resistor: fixed, composition, 12K, 5%, 1/2W	1067-1235	01121	EB1235	1	1		
R233	Resistor: fixed, composition, 3.3K, 5%, 1/2W	1067-3325	01121	EB3325	1	1		
RV1, 301	Varistor, 24V	1254-0003	04777	RY-56	2	1		
SCR201	Rectifier, silicon, 2N1595	1297-0013			1	1		
S1-25	Switch, multi, illuminated pushbutton	1852-0009	82389	75-1106	5	2		
	Lamps for above	None	71744	1775	25	6		
S201, S203	Switch, pushbutton, DPDT	1852-0002	82389	1006	2	1		

* Manufacturers' codes on last page. † Recommended 1-year isolated-use spares per MIL-E-17362A.

REFERENCE DESIGNATOR	DESCRIPTION	DYMEC STOCK NO.	*MFR. CODE	MFR. PART NO.	QTY.	†1-YR. SPA.
S202	Switch, rotary	1851-0037	71590	CRL PA023	1	1
T101	Transformer, power	1575-0040	Tranex Co.	4-0072	1	1
W101	Cable, power	3170-0001	70903	KH-3088	1	1
XA1	Connector, printed circuit, 24 pin	2535-0059	95354	SD624S-P6	1	1
XA2, 3	Connector, printed circuit, 24 pin	2535-0060	95354	SD624S-P21	2	1

---

* Manufacturers' codes on last page.

† Recommended 1-year isolated-use spares per MIL-E-17362A.

HANDBOOK
UPDATING SUPPLEMENT

for

MODEL DY-2901
INPUT SCANNER

Serials Prefixed: 144-

ITEM	DESCRIPTION (Parts Listing)
1	Change R231 to: Resistor, fixed, composition, 12K, 5%, 1/2 watt; 1067-1235; 01121; EB1235.
2	Add Channel ID Board 9010-0164 consisting of: Diodes: 1281-0045; 07933; RD1526. Resistors: fixed, composition, 12K, 5%, 1/2 watt; 1067-1235; 01121; EB1235.

2/65

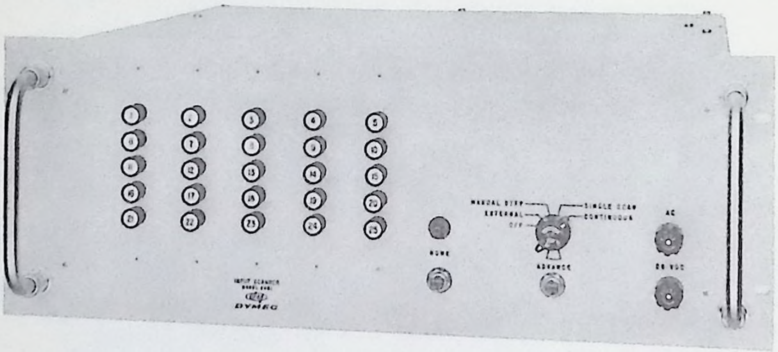
HANDBOOK

for

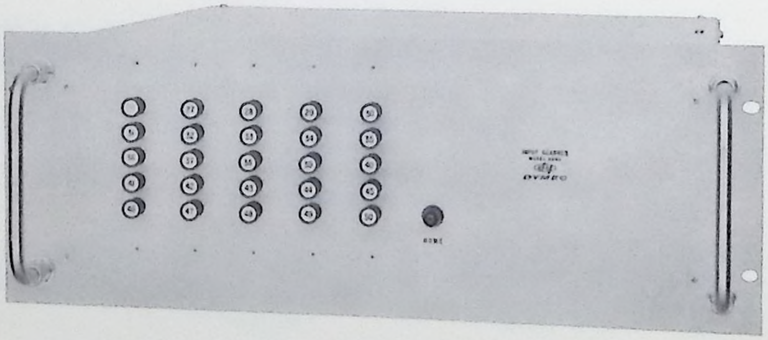
MODELS DY-2901/2/3/4

INPUT SCANNERS

Serials prefixed 116-



DY-2901 Master Input Scanner



DY-2902 Slave Input Scanner
(DY-2903/4 Scanners Similar)

Copyright DYMEC 1961
A Division of Hewlett-Packard Co.
395 Page Mill Road, Palo Alto, California

Pub. 10/61

Printed in U.S.A.

TABLE OF CONTENTS

Page No.

SECTION 1 GENERAL DESCRIPTION

1.1 Electrical Description 1-1
1.2 Physical Description 1-2
1.3 Specifications 1-2

SECTION 2 INSTALLATION AND OPERATION

2.1 Installation 2-1
2.2 Operation 2-4
  2.2.1 Channel Selection 2-5
  2.2.2 Operation of the HOME Push Button 2-5
  2.2.3 Program Boards 2-5
  2.2.4 Channel Identification Coding Cards 2-9

SECTION 3 DETAILED DESCRIPTION AND THEORY OF OPERATION

3.1 General Description 3-1
3.2 Control Circuits 3-2
3.3 Program Boards 3-5
3.4 Output Delay Switching Circuit 3-6
3.5 DY-2902/3/4 Slave Scanner Operation 3-7

SECTION 4 MAINTENANCE

4.1 General 4-1
4.2 Lubricating the Stepping Switch 4-9

SECTION 5 TABLE OF REPLACEABLE PARTS 5-1

SCHEMATIC DIAGRAMS

Figure 3.4 Interconnecting Diagram of DY-2901/2/3/4 Stepping Switch Off-Normal Contacts 3-9
Figure 4.6 DY-2901 Power Supply 4-15
Figure 4.7 DY-2901 Output Delay Switching and Programming Board Section 4-16
Figure 4.8 DY-2901 Control Circuit 4-17
Figure 4.9 DY-2901 Stepping Switch Circuits 4-18
Figure 4.10 DY-2902/3/4 Stepper Control Circuit 4-19
Figure 4.11 DY-2902/3/4 Stepping Switch Circuits 4-20

TABLES AND ILLUSTRATIONS

		Page No.
Figure 2.1	DY-2901 Rear Panel Connectors	2-2
Figure 2.2	DY-2901/2/3/4 Interconnecting Cabling Diagram	2-3
---	Programming examples	2-6, 7
Figure 2.3	DY-2901/2/3/4 Program Board Diagrams	2-8
Figure 2.4	Graph of Measurement Time Delays as a Function of Resistance for DY-2901/2/3/4 Program Boards, Section B	2-11
Figure 3.1	Overall Functional Block Diagram of DY-2901 Input Scanner	3-0
Figure 3.2	Functional Block Diagram of DY-2901 Input Scanner Control Circuit	3-3
Figure 3.3	DY-2901/2/3/4 Program Board Interconnections	3-6
Table 4.1	J101 Pin Connections	4-2
Table 4.2	J103 Pin Connections	4-3
Table 4.3	J104 Pin Connections	4-4
Table 4.4	J201 Pin Connections	4-5
Table 4.5	J202 Pin Connections	4-6
Table 4.6	J203 Pin Connections	4-7
Table 4.7	J204 Pin Connections	4-8
---	Type 45 Stepping Switch Lubrication Points	4-10
Figure 4.1	DY-2901 Top Internal View	4-11
Figure 4.2	DY-2901 Bottom Internal View	4-12
Figure 4.3	DY-2901 Control Circuit Plug-In Card	4-13
Figure 4.4	Channel Identification Coding Card for 10-Line and 4-2'-2-1 BCD	4-13
Figure 4.5	Channel Identification Coding Cards for Staircase Codes	4-14

SECTION 1
GENERAL DESCRIPTION

1.1 ELECTRICAL DESCRIPTION

The DY-2901 Input Scanner is a precision scanning device designed to sequentially scan input information signals of various types and levels, and connect the signals, channel-by-channel, to one set of measuring and recording equipment. Signals as small as a few millivolts, from sources such as thermocouples, thermistors, and strain gages, can be scanned with full accuracy preserved. Likewise, signals of several hundred volts can also be scanned. To accommodate multiple inputs of different types and levels, the DY-2901 will program the appropriate system operating functions and ranges needed for each channel. Up to 25 separate inputs can be scanned by the DY-2901 alone; by adding additional slave scanners (DY-2902, 3, & 4), a total of 100 inputs can be scanned.

The DY-2901 contains 25, numbered, channel selection push button switches for selecting or rejecting any or all of 25 inputs connected to individual shielded input connectors. Each input connector is gold-plated to lower contact resistance, and connections are soldered with low-thermal-emf solder; thus, small signals (typically 2 to 3 uv) can be accurately transferred. If an input channel is to be measured, the corresponding switch is depressed and a lamp within the switch lights at half-brightness. As the stepping switch in the DY-2901 steps to each selected channel, the lamp corresponding to the channel being measured is illuminated to full brightness. All unselected channels are automatically skipped in the scanning sequence.

The DY-2901 has four modes of operation selected by a front-panel switch. Two of the modes are for manual or external control. These modes are used to advance the scanner from one preselected channel to the next by operation of a front-panel push button or by receipt of an external contact closure or pulse. Another mode allows a single, complete set of measurements and recordings of all selected channels to be taken. (This includes all selected channels on any slave scanners used also.) The fourth mode allows all selected channels to be repeatedly scanned as rapidly as the measuring and recording equipment will permit in closed loop operation.

To allow for various stabilization and settling times that may be required by dc amplifiers and ac measuring devices in a system, the DY-2901 contains a measurement delay circuit which can be programmed to provide one of four preselected delays, ranging from 25 to 750 milliseconds, at each input channel. The desired delay is programmed by inserting a shorting pin at one of three points for each channel in a 3-row, 25-column program pinboard. (No pins inserted provides maximum delay.)

In addition to the measurement delays that can be programmed, another program board (25 x 15-point) is provided for programming up to 15 internal/external functions per input channel. Programming of these functions is accomplished by inserting a combination of shorting pins and isolation diode pins in the pinboard as necessary. If it is required to program more than 15 operating functions, a second (similar) programming board can be installed.

As each input signal is scanned by the DY-2901, a two-digit channel identification signal is internally generated and coupled to the system recording equipment via two plug-in printed circuit coding cards (one card for each digit). The standard coding cards supplied with the DY-2901 provide the channel identification output in 10-line form. However, alternate coding cards can be obtained to provide the channel identification outputs in forms such as 4-line binary-coded-decimal (4-2'-2-1, 8-4-2-1, etc.), or staircase.

The DY-2902, 3, and 4 Input Scanners are slave units that can be connected to the master DY-2901 to increase the scanning capabilities to a maximum of 100 input points (25 points per unit). The slave units are similar to the DY-2901 master, but utilize the power supply, operating mode switch, and measurement delay circuitry in the master for their operation. The slave units contain a program pinboard, identical to that in the DY-2901, for programming system functions and measurement delays for their own channels. (The actual delay times are derived from the DY-2901.) Dual program boards can also be installed (as a factory option) in the slave units. Channel identification is supplied by the slave units to the DY-2901 in 10-line code, and routed to the external system via the plug-in translation cards installed in the DY-2901.

1.2 PHYSICAL DESCRIPTION

The DY-2901, 2, 3, and 4 are identical in external dimensions, and each is designed to mount in a standard 19-inch wide rack with 7 inches of panel space. The depth behind the front panel is 17½ inches, including attached connectors. Individual quick-connect/disconnect connectors are provided for each input channel and for signal outputs. The front-panels are finished in light-grey baked enamel with black-filled engraved control titles.

1.3 SPECIFICATIONS

Signal Circuit

Number of Channels:	1 to 25 floating signal pairs with shields. (Can be increased to 100 channels with DY-2902, 3, & 4 Slave Scanners.)
Voltage Range:	Lower limit determined by thermal emf — typically 2 to 3 uv at room temp. Upper limit 500 v peak.
Resistance:	Input to output resistance typically 50 milliohms, or 90 milliohms via output switching circuit.

Maximum Frequency:	Maximum recommended frequency through scanning switch is 100 kc. Signal amplitude (volts rms) times frequency should not exceed 10^6.
Input Connectors:	Cannon XLR-3-32-A95 (3-pin, gold-plated) for each channel.
Output Connectors:	Direct output is via one Cannon XLR-3-32-A95. (Similar connector is provided for slaving purposes.) Switched output is directed to two Cannon XLR-3-32-A95 and one BNC.
Channel Identification	
Code:	Standard instrument supplies floating contact-closure 10-line code. Translator cards can be added to provide other codes (see "Accessories Available").
Connector:	One MS3102A28-21S (37-pin).
Operating Modes	
Manual Step:	Step initiated by front-panel push button.
External:	Step initiated by external contact closure or -15 v pulse (rise time 100 us or less).
Single Scan:	Scan initiated by front-panel push button, external contact closure, or -15 v pulse (rise time 100 us or less). Scan sustained by -15 v advance pulse or contact closure upon completion of each measuring/recording function.
Continuous:	Scan automatically initiated at end of each cycle. Scan sustained by -15 v advance pulse or contact closure upon completion of each measuring/recording function.
Scanning Speed:	Maximum scanning speed typically 14 to 15 channels per second.
Measurement Delays:	Choice of 25, 50, 150, or 750 ms (approx.) may be programmed for each channel. Instrument easily modified by user to obtain other delays within this range.

Program Outputs

Number of Functions: 15 program lines for control of external functions. Internal pinboard permits any or all of these lines to be activated as each data point is selected. No activation on skipped points. (Additional pinboard to program 15 more lines can be provided. See "Features Available".)

Connector: One MS3102A28-21P (37-pin).

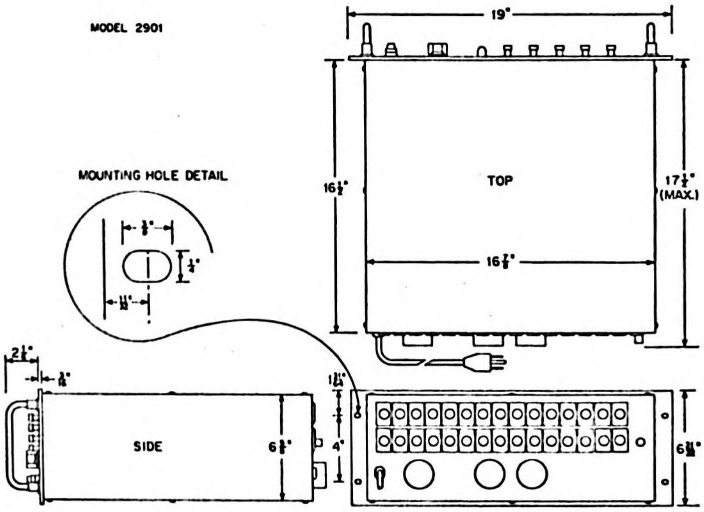
Power Available:

26 vdc, 0.5 amp, at all MS connectors (positive side connected to chassis ground). Optionally, 48 vdc at 0.5 amp can be supplied.

Power Required:

115/230 v, ±10%, 50/60 cps, 20 watts approx. (40 watts max with slave units).

Dimensions



Weight

Net, 33 lb. Shipping, 50 lb.

Panel Finish

Light grey baked enamel. Black-filled engraved letters.

DY-2901 Accessories Furnished

1. 25 mating input connectors, Cannon XLR-3-11C-A95.
2. 3 mating output connectors, Cannon XLR-3-11C-A95.
3. Mating connectors for channel identification output and control inputs, MS3106B28-21P (with clamp).

4. Mating connector for program output, MS3106B28-21S (with clamp).

5. Mating connector for slave connector, MS3106B28-21S (jumpered for operating DY-2901 without slaves).

6. 25 program board shorting pins (for delay circuit).

DY-2902, 3, 4 Accessories Furnished

1. 25 mating input connectors (same as DY-2901).

2. 3-foot interconnecting cable for signal output (stock no. 9030-0061).

3. 3-foot interconnecting cable for control and channel identification (stock no. 9030-0060).

4. 3-foot interconnecting cable for program output (stock no. 9030-0060).

5. 25 program board shorting pins (for delay circuit).

Accessories Available

(Accessories 1 & 2 apply to the DY-2901 and the slave scanners. Accessories 3 & 4 apply to the DY-2901 only.)

1. **Program Board Shorting Pins:** Available in sets of ten (stock no. 2585-0007).

2. **Program Board Diode Pins:** Available in sets of five mounted for anode connection to DY-2901 program ground (stock no. 9010 0063), or mounted for cathode connection to program ground (stock no. 9010-0069). Diode rating is 200 ma max. forward current, 100 v peak inverse voltage.

3. **BCD Channel Identification Translator:** Provides 4-2'-2-1 code, positive for "true" (requires external voltage). Stock no. 9010-0073.
   Note: Translators to provide negative true 4-2'-2-1 code, or other 4-line fixed weight bcd codes (e.g., 8-4-2-1), positive or negative true, may be obtained on special order.

4. Staircase Channel Identification Translator
   Provides 1-line staircase code voltages (stock no. 9010-0066).

Features Available
(factory installed)

1. A second, independent channel identification output.
2. Additional programming board (and output connector).

SECTION 2
INSTALLATION AND OPERATION

2.1 INSTALLATION

The DY-2901, 2, 3, and 4 each mount in a standard 19-inch wide rack with no special provisions being required for ventilation. The DY-2901 contains a power supply which provides power for itself and any slave scanners connected. This power supply comes from the factory wired for 115-volt, 50/60 cycle operation, but may be converted for 230-volt operation by rewiring the primary terminals of the power transformer and replacing the line fuse as shown in the schematic drawing of the power supply.

To interconnect the input scanner(s) in a system, refer to the interconnecting cabling diagram shown in Figure 2.2 and to the following description of the connector functions.

J1-J25 (DY-2901): J26-J50 (DY-2902): J51-J75 (DY-2903): J76-J100 (DY-2904):	XLR-3-32-A95 (3-pin gold plated). Receives the shielded two-wire floating inputs from external sources in the order of scanning desired.
J110,J111 (DY-2901): J210,J211 (DY-2902): J310,J311 (DY-2903): J410,J411 (DY-2904):	XLR-3-32-A95 (3-pin gold plated). Parallel connectors. These connectors provide for interconnecting the output signals from the slave scanners with the DY-2901. J110 (or J111) provides the undelayed signal outputs from all scanners to the external system measuring equipment.
J109,J113,J114 (DY-2901):	J109 is a BNC connector used for delayed frequency outputs. J113 and J114 are XLR-3-32-A95 connectors used for delayed outputs of resistance and ac-dc data, respectively. Note: These connectors are only used when the external measuring units require interrupted delayed outputs for channel-to-channel measurements. Otherwise, J110 or J111 is used.
J101 (DY-2901): J201 (DY-2902): J301 (DY-2903): J401 (DY-2904):	MS3102A28-21P (37-pin). These connectors route the program board functions. When slave scanners are used, J101 connects to J202, J201 to J302, and J301 to J402. The programmed measurement delay functions are routed to the DY-2901. The programmed contact closures for external operating functions are routed to the external equipment via the last scanner in the sequence.

J202 (DY-2902): J302 (DY-2903): J402 (DY-2904):	MS3102A28-21S (37-pin). Used to interconnect program board functions from scanner to scanner as described above. (Similar connector in DY-2901 is not necessary.)
J103 (DY-2901): J203 (DY-2902): J303 (DY-2903): J403 (DY-2904):	MS3102A28-21P (37-pin). These connectors route the control signals between scanners and route the channel identification data from the slave scanners to the DY-2901. J103 connects to J204, J203 to J304, and J303 to J404. The last scanner in the sequence must have this connector connected to a dummy plug which interlocks the control circuits for all of the scanners.
J104 (DY-2901): J204 (DY-2902): J304 (DY-2903): J404 (DY-2904):	MS3102A28-21S (37-pin). J204, J304, and J404 are used to interconnect the scanners for the control signal and channel identification functions as described above. J104 is used to connect system control signals and channel identification information to the external equipment.

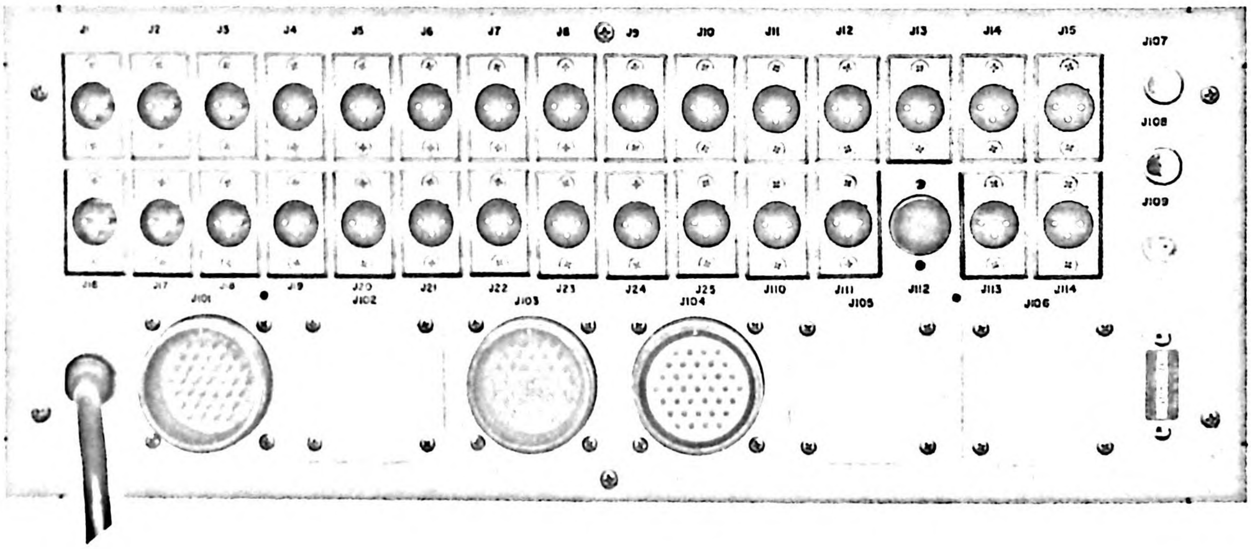
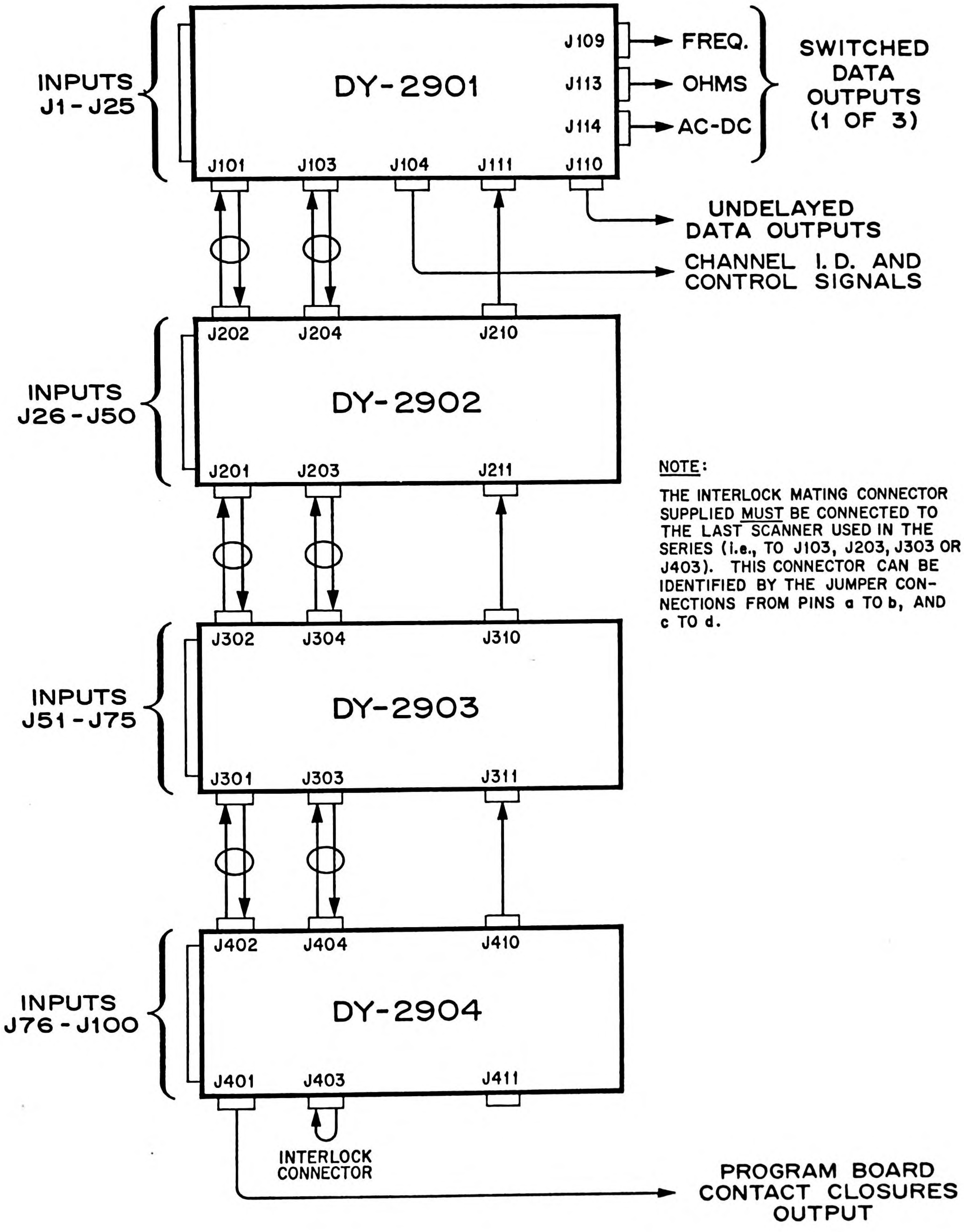


FIGURE 2.1. DY-2901 REAR PANEL CONNECTORS



NOTE:

THE INTERLOCK MATING CONNECTOR SUPPLIED MUST BE CONNECTED TO THE LAST SCANNER USED IN THE SERIES (i.e., TO J103, J203, J303 OR J403). THIS CONNECTOR CAN BE IDENTIFIED BY THE JUMPER CONNECTIONS FROM PINS a TO b, AND c TO d.

FIGURE 2.2. DY-2901/2/3/4 INTERCONNECTING CABLING DIAGRAM

2.2 OPERATION

The input scanners, themselves, require no warm-up time for reliable operation. However, the system in which they are used, normally requires a minimum warm-up period determined by the types of units present.

There are basically four modes of operation for the input scanners. The particular mode employed is determined by the position of the front-panel mode selector switch on the DY-2901. The possible settings are: (1) EXTERNAL, (2) MANUAL STEP, (3) SINGLE SCAN, and (4) CONTINUOUS. Operation in each of these positions is described below.

EXTERNAL: This mode of operation permits controlling the stepping from channel to channel from an external position. To operate in this mode, set the mode selector switch to the EXTERNAL position and apply a negative-going pulse (min. of 15 volts, max. rise-time of 100 us) to pin k of J104 each time it is desired that the scanner advance to the next channel position. This advance pulse can be obtained by providing a contact closure between pins j (-26 vdc) and k of J104 if desired.

MANUAL STEP: This mode is primarily used to facilitate system set-up and examination of individual channels. To operate in this mode, set the mode selector switch to MANUAL STEP and depress the ADVANCE push button momentarily each time it is desired that the scanner advance to the next channel position.

SINGLE SCAN: This mode is normally used when a single complete scan cycle of all selected input channels is desired. To operate in this mode, place the mode selector switch in the SINGLE SCAN position. A scan cycle can then be initiated by either momentarily depressing the ADVANCE push button or by providing a momentary contact closure between pins e and h of J104. To complete the cycle a negative - going channel advance pulse at the end of each channel recording must be received through pin m or f of J104. Large channel advance pulses, such as provided by Dymec output couplers and most Hewlett-Packard recorders, must be applied to J104m in through the 39K dropping resistor (R203). When an instrument providing only small channel advance signals (15 volts min.), such as provided by many solid-state instruments, is used, the signal should be applied through J104f.

In this mode of operation, continuous scanning for any number of complete cycles can be obtained by holding the ADVANCE push button depressed, or by maintaining the contact closure between pins e and h of J104.

CONTINUOUS: This mode is normally used when it is desired to automatically repeat complete scan cycles of all selected input channels. In this mode of operation a scan cycle is initiated as soon as the mode selector is placed in the CONTINUOUS position, and each time the stepper arm reaches the home (normal) position at the end of each cycle. To complete a scan cycle after initiation, a negative-going channel-advance pulse must be received through pin m or f of J104 at the end of each channel recording, as explained for single scan operation.

2.2.1 Channel Selection

Channels to be scanned are selected by depressing the numbered channel selector push buttons on the front panel of the master and any slave scanners connected. When a push button is depressed, a lamp within the switch lights at half-brightness, indicating that that channel has been selected to be scanned. All channels that are not lighted will be skipped in the scanning sequence.

2.2.2 Operation of the HOME Push Button

The HOME push button can be used to advance the stepping switch to the home (normal) position at any time during a scan cycle, and thus skip the remaining channels not yet scanned in the cycle. To accomplish this, the push button must be held depressed until the steppers reach home.

2.2.3 Program Boards

When a DY-2901/2/3/4 Input Scanner(s) is included as part of a system supplied by the factory, shorting pins and/or isolating diode pins are inserted in the program board(s) in positions dictated by the system requirements. In these cases a diagram of each program board, such as shown in Figure 2.3, is provided with the handbook showing the positions of the programming pins. To change the programming, or to initially program the required functions, refer to the following instructions for inserting programming pins in sections A and B of the boards.

Section A (contact closures): To program contact closures for external operating functions, isolating diode pins and/or shorting pins should be inserted in rows 3 through 15 as determined by the number of functions to be programmed at each channel. (Rows 1 and 2 are normally reserved for programming the output delay switching relays K304 and K303, respectively.) If only one function is to be programmed per channel, shorting pins alone can be used. If more than one function is to be programmed at a given channel, it will normally be required to use a combination of shorting and diode pins in order to prevent functions programmed at that channel from also being programmed at other channels (when undesired).

A method for determining the position of diode pins for multiple function programming is to first draw a grid network representing the program board (the diagrams shown in Figure 2.3 can be used if desired), and then draw in shorting pin symbols at the rows and channel positions where programming is desired. After all programming positions have been selected, the programmed current paths for each channel must be traced through the other channel positions to determine if additional paths exist whereby functions other than those desired at the given channel will be programmed. Whenever a path exists which would cause an unwanted function to be programmed at a given channel, a diode pin must be inserted in place of the shorting pin that completes the path to the channel that contains the unwanted function.

When programming to a negative supply voltage, a diode pin having the anode connected to the program common (P/N 9010-0063) must be used; when programming to a positive supply, a diode pin having its cathode connected to the program ground (P/N 9010-0069) must be used. The diode pin type can be identified by removing the pin cap and observing the direction in which the diode is connected. If the direction is wrong for the voltage polarity used, the diode element can easily be reversed in the pin cap.

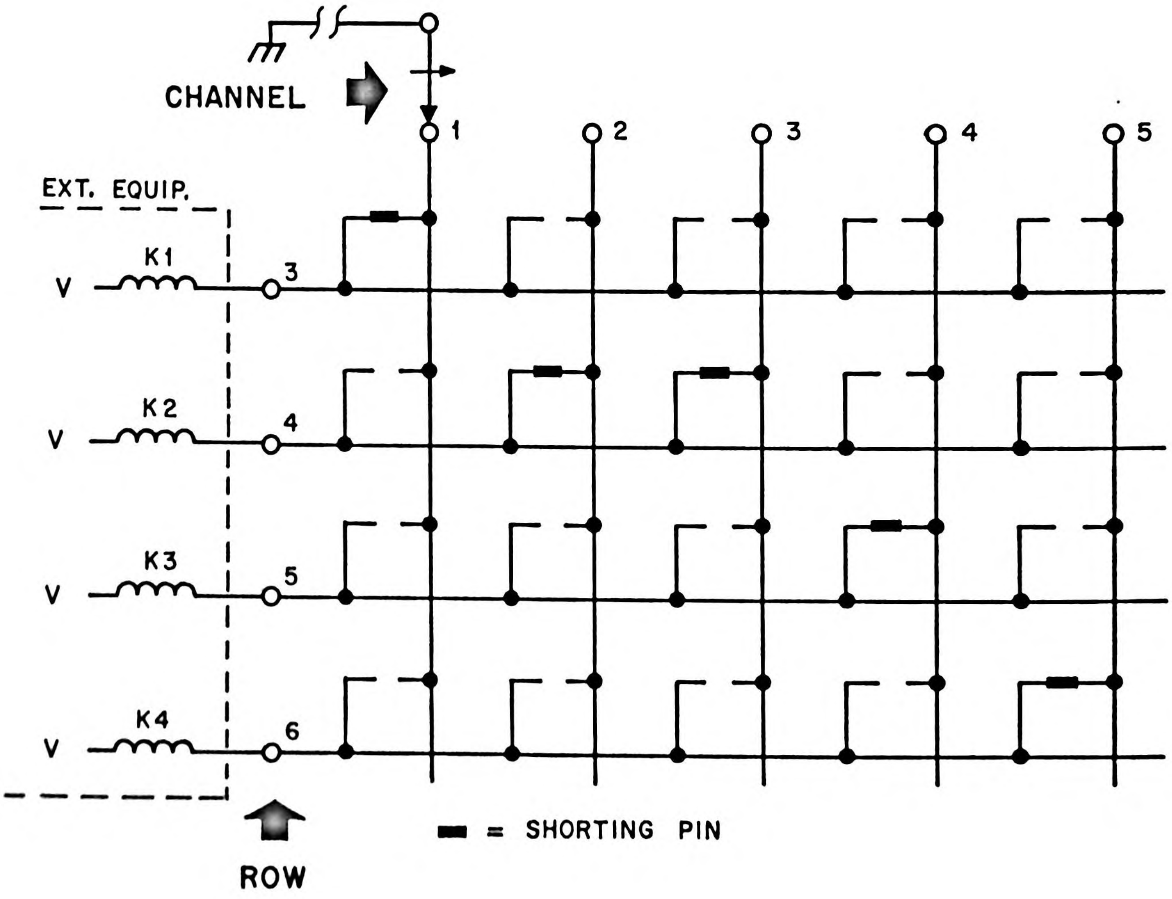
Note: It is not possible to program to both a positive and negative voltage source on the same channel. However, unequal voltages of the same polarity can be used for programming.

The following programming examples should be helpful in setting up a program.

EXAMPLE 1: Single function per channel programming.

Program:

Channel 1: Relay K1 to be energized.
Channel 2: Relay K2 to be energized.
Channel 3: Relay K2 to be energized.
Channel 4: Relay K3 to be energized.
Channel 5: Relay K4 to be energized.

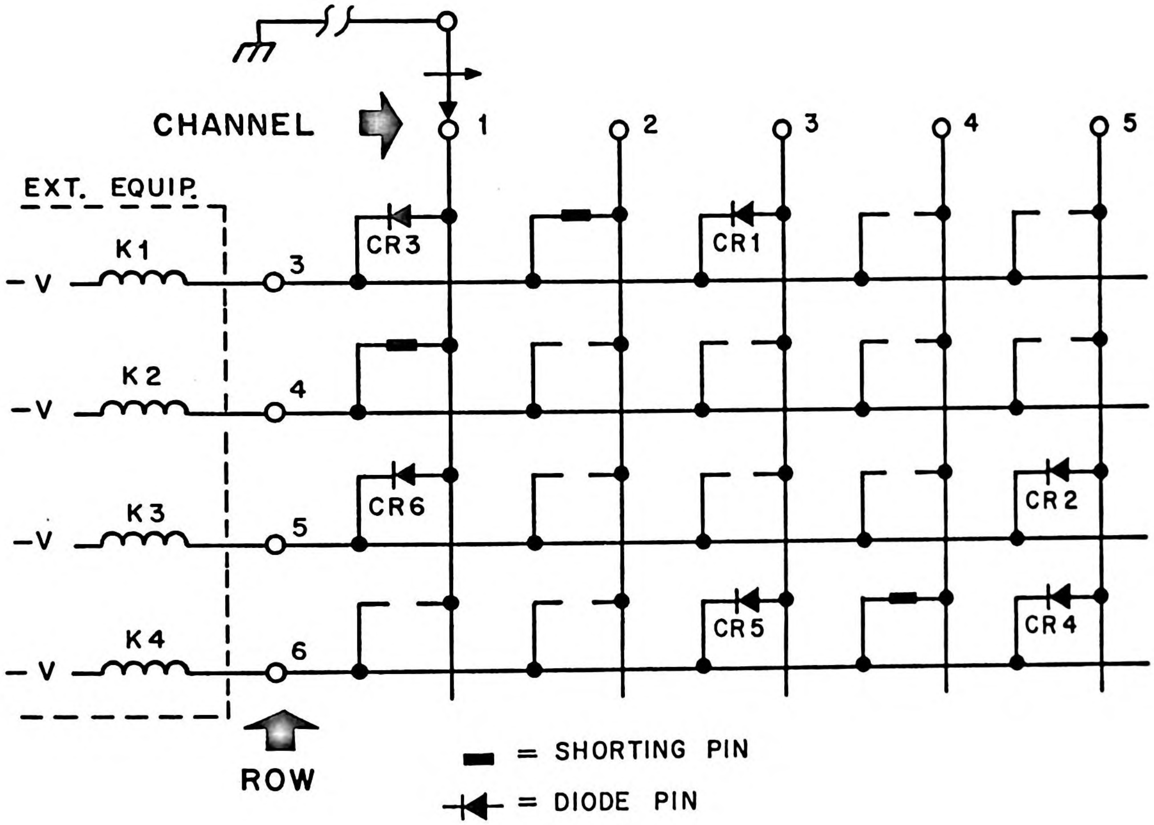


Explanation:
No isolating diode pins required, since only one function is programmed per channel.

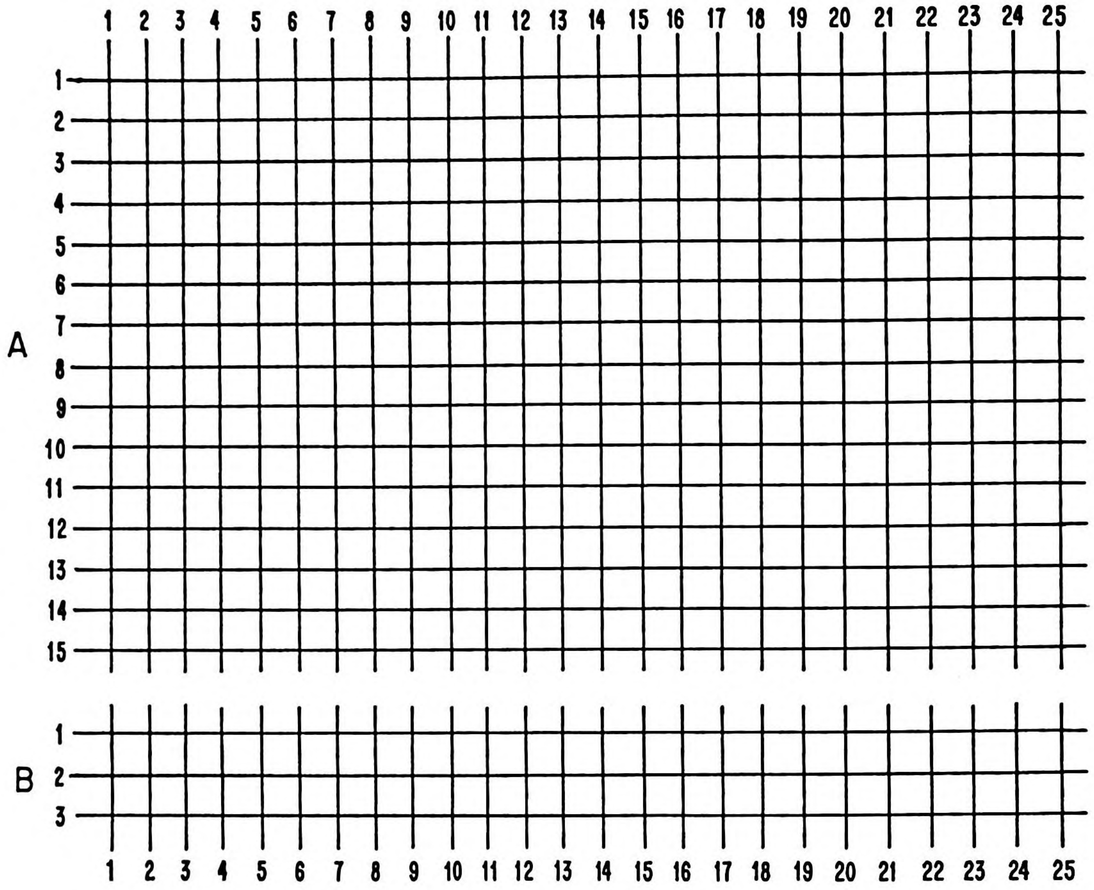
EXAMPLE 2: Multiple function per channel programming.

Program:

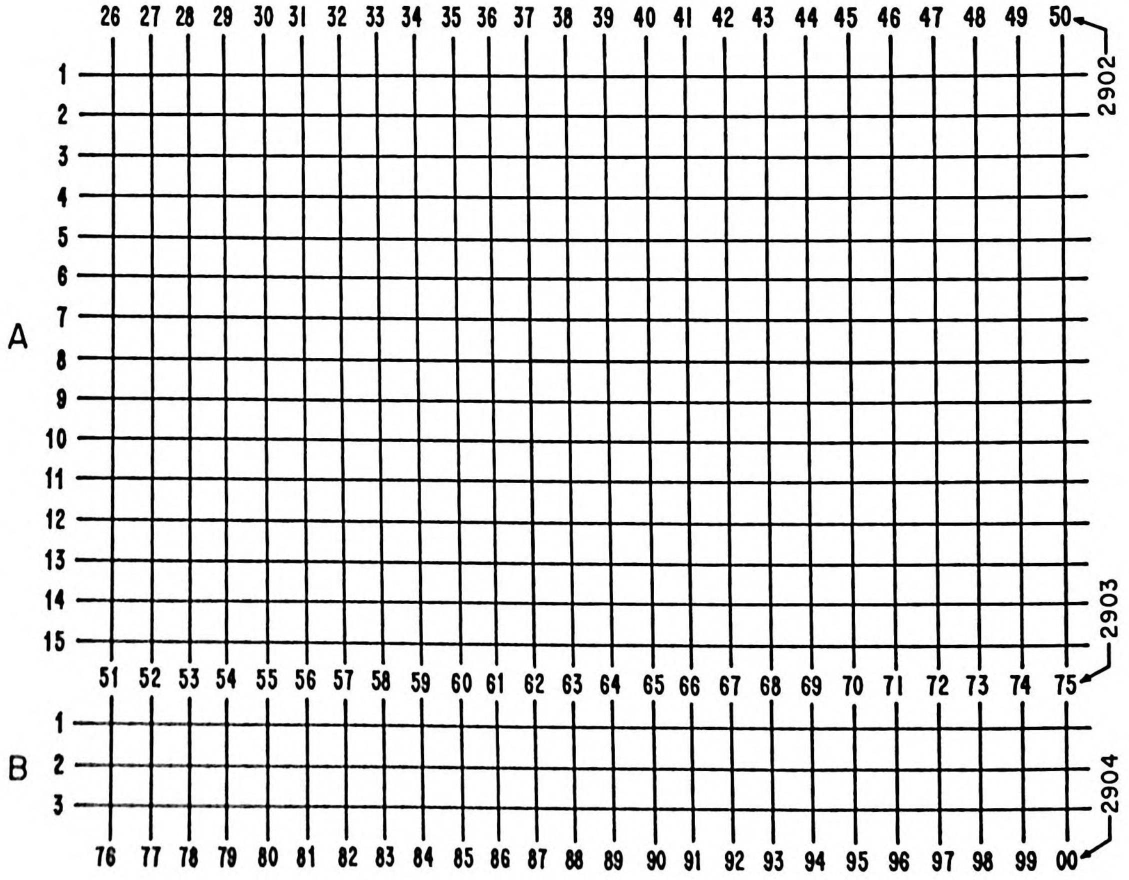
Channel 1: Relays K1, K2, & K3 to be energized.
Channel 2: Relay K1 to be energized.
Channel 3: Relays K1 & K4 to be energized.
Channel 4: Relay K4 to be energized.
Channel 5: Relays K3 & K4 to be energized.



Explanation:
CR1 isolates K4 when on channels 1 and 2.
CR2 isolates K4 when on channel 1.
CR3 isolates K2 & K3 when on channels 2 and 3.
CR4 isolates K3 when on channels 3 and 4.
CR5 isolates K1 when on channels 4 and 5.
CR6 isolates K1 & K2 when on channel 5.



DY-2901 PROGRAM BOARD PIN POSITIONS



DY-2902/3/4 PROGRAM BOARD PIN POSITIONS

FIGURE 2.3. DY-2901/2/3/4 PROGRAM BOARD DIAGRAMS

Section B (time delays): To program the measurement time delays insert a shorting pin (diode pins not required) in row 1, 2, or 3 at each channel position for the delay desired. Row 1B provides a measurement delay of approximately 25 milliseconds, 2B provides 50 milliseconds, and 3B provides 150 milliseconds. If no pins are inserted a maximum delay of approximately 750 milliseconds is obtained. Other time delays in the range of 25 to 750 milliseconds can be obtained in any row by substituting resistance values for R205 (row 3B), R206 (row 2B), and R207 (row 1B). The approximate resistance value for a given time delay can be obtained from the graphs shown in Figure 2.4. Note that these values are only approximate. If more accurate time delays are required, refer to the procedure outlined below for selecting resistance values.

1. Connect an oscilloscope to pin p of J104, and position the trace dot at some convenient reference point.

2. Connect a potentiometer or decade resistance box in place of the time delay resistor to be changed, and place shorting pins in the associated program board row.

3. Place the scanner mode selector switch in the MANUAL STEP position.

4. Press the ADVANCE push button and observe the pulse display on the oscilloscope. The time between the leading and trailing edge of the pulse is the time delay of interest.

5. Adjust the resistance value until the desired time delay is obtained, and then install a resistor of that value in place of the resistor removed.

2.2.4 Channel Identification Coding Cards

The two channel identification coding cards supplied with each input scanner are inserted in the keyed connectors, A2 and A3, to provide two digits of channel identification to external recording equipment. Each standard coding card provides a 10-line code and has provisions for adding a second code in any one of the 4-line binary-coded-decimal forms (4-2'-2-1, 8-4-2-1, etc.). This second code consists of adding coding diodes to the printed circuit card and is normally accomplished at the factory. Additionally, channel identification cards providing a 10-line code and a staircase code can also be obtained on special order. Each coding card can be inserted in its connector in one of two ways to provide either the 10-line code or the alternate code translation.

When 4-line bcd coding cards are used, an external voltage must be connected to pin 20 of the card connectors, A2 and A3, (i.e., at J104K for the units card, A2, and at J104X for the tens card, A3) if a voltage swing between the binary numbers "0" and "1" is required for detection by the external equipment. The levels F and G stepper arms should be grounded by grounding J104A and M for the units and tens digits, respectively. (Note: As the equipment comes from the factory, only a contact closure or no contact closure is provided for the binary numbers "1" and "0", respectively.) When the bcd cards are connected as described above, the output will be 0 volts for a "1", and the voltage level connected, for a "0".

If staircase channel identification cards are used, a highly regulated +300 volts dc must be supplied to the staircase cards through J104g. This voltage is normally obtained from the external equipment that is to receive and detect the staircase output voltages, such as a digital recorder.

When DY-2902/3/4 slave scanners are used, the coding cards for these units provide only 10-line code connections, no matter which output code is desired. The 10-line outputs from these units are then coupled to the DY-2901 master scanner where the code translation takes place according to the position of its coding cards.

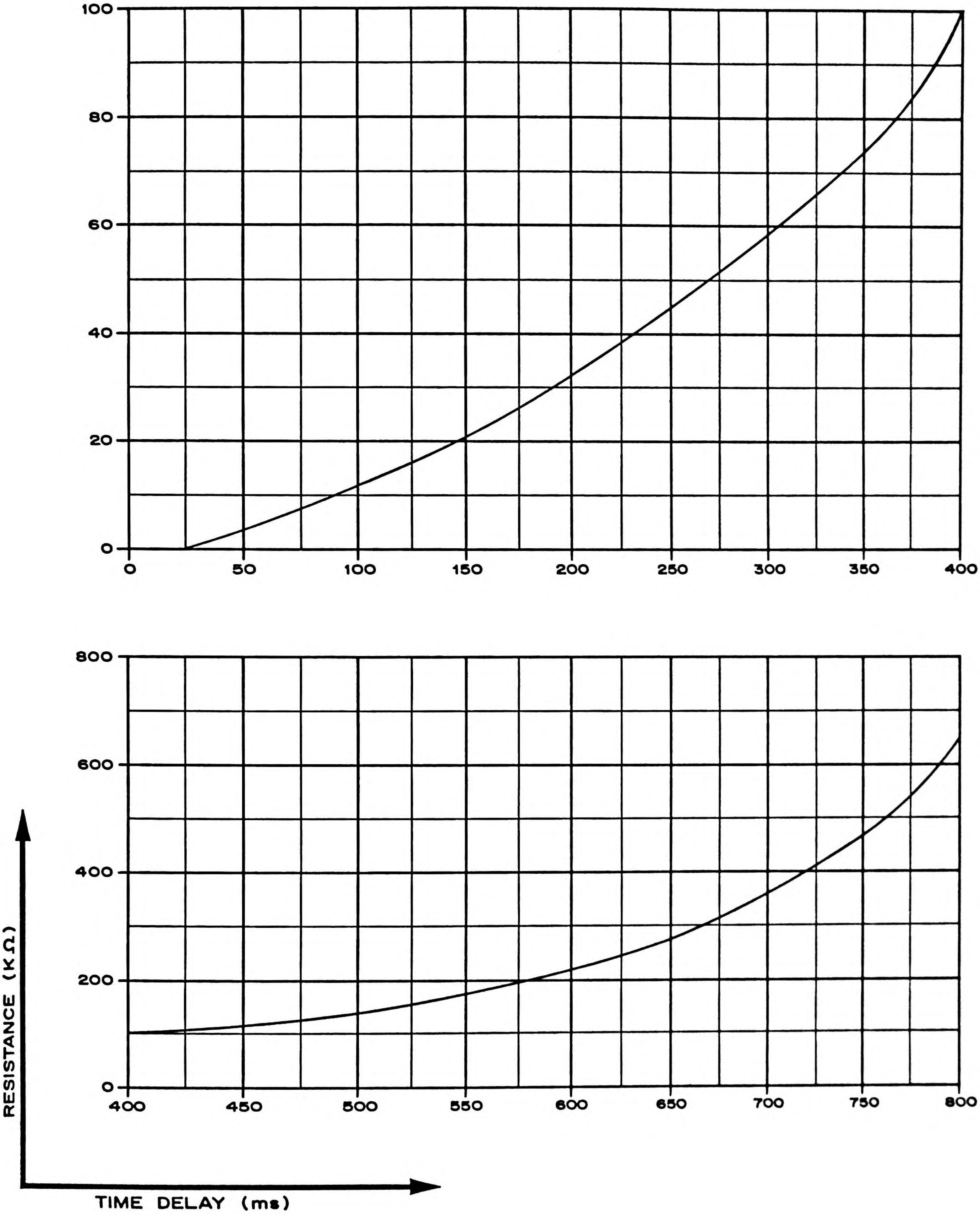


FIGURE 2.4. GRAPH OF MEASUREMENT TIME DELAYS AS A FUNCTION OF RESISTANCE FOR DY-2901/2/3/4 PROGRAM BOARDS, SECTION B.

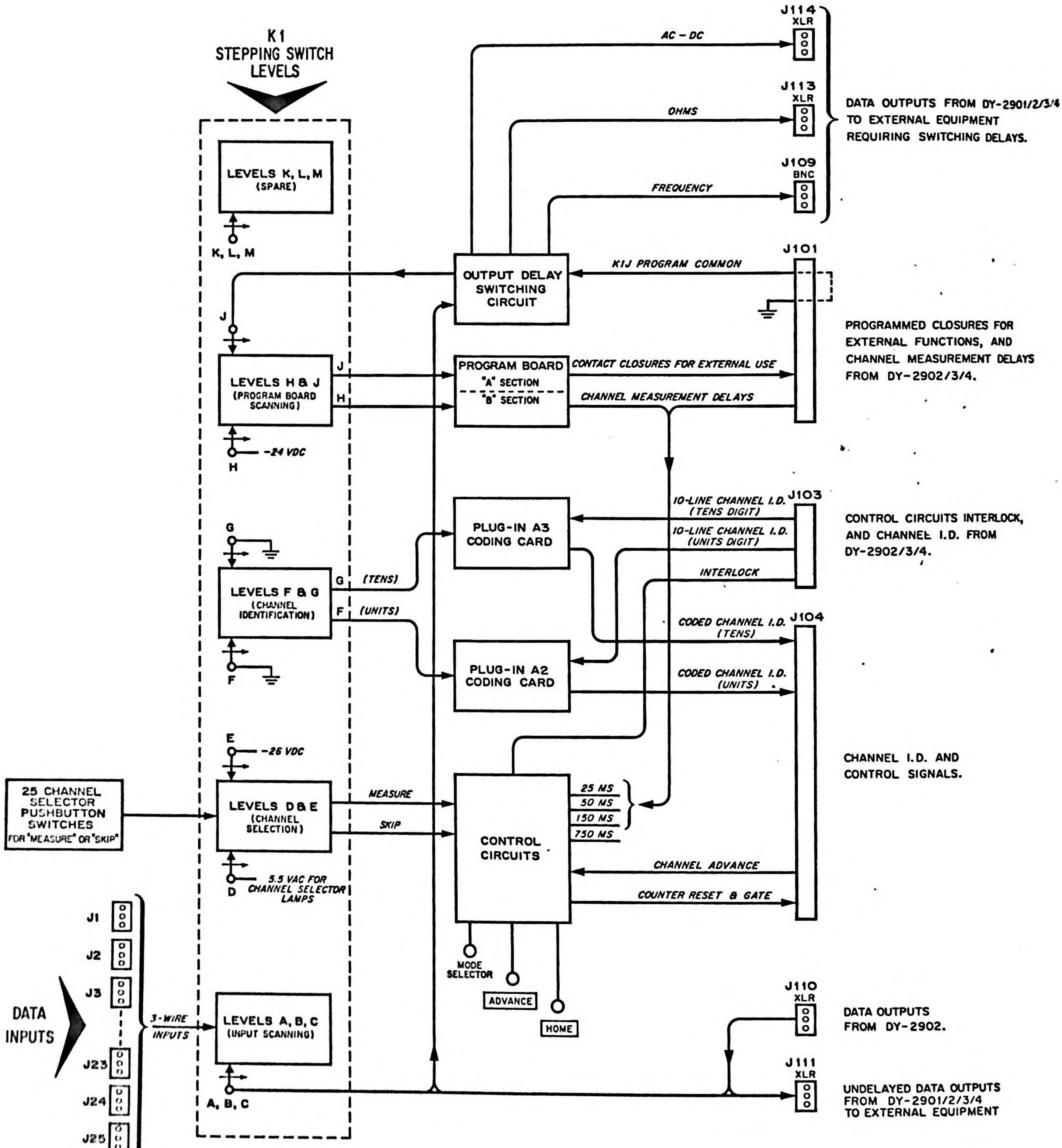

K1
STEPPING SWITCH
LEVELS
LEVELS K, L, M
(SPARE)
K, L, M
J
LEVELS H & J
(PROGRAM BOARD SCANNING)
J
H
-24 VDC
H
G
LEVELS F & G
(CHANNEL IDENTIFICATION)
G
F
(TENS)
(UNITS)
F
E
-26 VDC
25 CHANNEL SELECTOR PUSHBUTTON SWITCHES
FOR "MEASURE" OR "SKIP"
LEVELS D & E
(CHANNEL SELECTION)
MEASURE
SKIP
D
5.5 VAC FOR CHANNEL SELECTOR LAMPS
J1
J2
J3
J23
J24
J25
DATA INPUTS
3-WIRE INPUTS
LEVELS A, B, C
(INPUT SCANNING)
A, B, C
AC - DC
OHMS
FREQUENCY
J114
XLR
J113
XLR
J109
BNC
DATA OUTPUTS FROM DY-2901/2/3/4 TO EXTERNAL EQUIPMENT REQUIRING SWITCHING DELAYS.
OUTPUT DELAY SWITCHING CIRCUIT
K1J PROGRAM COMMON
J101
PROGRAM BOARD
"A" SECTION
"B" SECTION
CONTACT CLOSURES FOR EXTERNAL USE
CHANNEL MEASUREMENT DELAYS
PROGRAMMED CLOSURES FOR EXTERNAL FUNCTIONS, AND CHANNEL MEASUREMENT DELAYS FROM DY-2902/3/4.
PLUG-IN A3 CODING CARD
10-LINE CHANNEL I.D. (TENS DIGIT)
10-LINE CHANNEL I.D. (UNITS DIGIT)
J103
INTERLOCK
CONTROL CIRCUITS INTERLOCK, AND CHANNEL I.D. FROM DY-2902/3/4.
CODED CHANNEL I.D. (TENS)
J104
PLUG-IN A2 CODING CARD
CODED CHANNEL I.D. (UNITS)
CHANNEL I.D. AND CONTROL SIGNALS.
CONTROL CIRCUITS
25 MS
50 MS
150 MS
750 MS
CHANNEL ADVANCE
COUNTER RESET & GATE
MODE SELECTOR
ADVANCE
HOME
J110
XLR
DATA OUTPUTS FROM DY-2902.
J111
XLR
UNDELAYED DATA OUTPUTS FROM DY-2901/2/3/4 TO EXTERNAL EQUIPMENT

FIGURE 3.1. OVERALL FUNCTIONAL BLOCK DIAGRAM OF DY-2901 INPUT SCANNER

SECTION 3
DETAILED DESCRIPTION AND THEORY OF OPERATION

3.1 GENERAL DESCRIPTION

Referring to the overall functional block diagram, the DY-2901 contains a 12-level, 25-position stepping switch, individual channel-selection push button switches, scan control circuits, two channel identification coding cards, a programming board to provide channel time delays and contact closures for external use, output delay switching circuits, and a power supply.

The data inputs are applied to levels A, B, and C of the stepping switch through the three-pin input connectors J1 through J25. Two of the pins allow the input to be floating and the third pin provides a shield. Levels D and E are wired with illuminated channel selection switches. Level D contains the illuminated switch lamps which increase in intensity as each lamp's associated input channel is scanned. Level E contains the channel selection switches which can be set to include or skip any input from the scanning cycle, If a switch is set to skip a particular channel, that channel's switch lamp will be extinguished. Levels F and G are used to provide two digits of channel identification information for each input channel scanned. This information can be provided in various code forms as may be required by external recording equipment in a system. Levels H and J are used for programming board connections to provide channel measurement time delays and contact closures for external use. Level H is used for the time delays and level J is for the contact closures. The remaining levels, K, L, and M, are normally unused, but may be wired for additional functions if required.

The DY-2901 has various modes of operation, each determined by the position of the front-panel mode selector switch. This selector forms part of the control circuits and can be set so that the scanner can be locally or remotely stepped from channel-to-channel, or automatically make a single or continuous scan of all channels.

The control circuits determine when the stepping switch steps from channel-to-channel and the push button selection switches determine if each channel's data is to be measured or skipped. When the control circuits receive a local (manual) command or an externally supplied channel advance signal, the stepping switch steps one position and connects the input data on that channel to external measuring equipment. If that channel's data is to be measured, a -26 vdc signal is coupled from the level E stepper to the control circuits via the measure buss. A measure command is then generated in the control circuits and coupled to an external unit in the system (e.g., a counter), allowing the data to be measured. If the channel's data is to be skipped, the -26 vdc signal from the level E stepper arm is coupled to the control circuits via the skip buss, and no measure command is generated. The stepping switch then immediately steps to the next channel.

As the stepping switch steps to each channel position and connects the input data to external measuring equipment, a two-digit channel identification number is connected from levels F and G to the external recording equipment via coding cards. For codes in 10-line or any of the 4-line, bcd code forms, the identification data is generated by the levels F and G stepping arms providing a ground contact closure at each channel position. This ground closure is routed through the coding cards to provide the desired translation. For codes in staircase code form, the channel identification data is generated by the levels F and G stepping arms picking off a different staircase code voltage at each channel position and connecting it to the external equipment. The staircase voltages are generated by a divider network mounted on the coding card, with the voltage source being supplied by the external recorder.

The program board allows various time delays and contact closures to be programmed for each of 25 channel positions of the stepping switch. The board is divided into two sections. Section A contains 25 x 15 positions, allowing up to 15 contact closures to be programmed by insertion of shorting pins and/or isolating diode pins for each of the 25 channels. These contact closures are available for use externally as required. Section B contains 25 x 3 positions, allowing time delays to be programmed by insertion of a shorting pin in one of the three positions for each channel. The time delays are applied to the control circuits and determine the time when a measure command is coupled to the external measuring unit after the stepper arms step to a given position. These delays are used to allow for various stabilization and settling times which may be required by the external measuring equipment in a system.

The output delay switching circuit is provided to momentarily disconnect the data output of the scanner from certain types of external measuring devices which require an open-circuit input when switching from one measurement level or parameter to another. This feature provides versatility in selecting the type of output device to be operated with the scanner. External devices which do not require these open-circuit switching conditions are connected to the undelayed output connector of the scanner, and therefore, do not utilize the output delay switching circuit.

3.2 CONTROL CIRCUITS

The control circuits contain the mode selector switch which primarily determines the type of operation of the input scanner. The four modes of operation are: (1) EXTERNAL, (2) MANUAL STEP, (3) SINGLE SCAN, and (4) CONTINUOUS. In each of these modes the operation of the control circuits is basically the same, and that is, to control the scanning operation.

Scanning of the input data is accomplished by the action of the stepping switch relay which causes the stepper arm on each of the 12 levels to advance one position each time the armature is released, rather than when it is energized. Assuming that the mode selector switch is in the SINGLE SCAN position and the scanner is at "home", a scan cycle is initiated by either depressing the ADVANCE push button or by a contact closure between pins e and h of J104. At this time -26 vdc is connected from the K1E home position, through the mode selector switch, to energize stepping relay K1

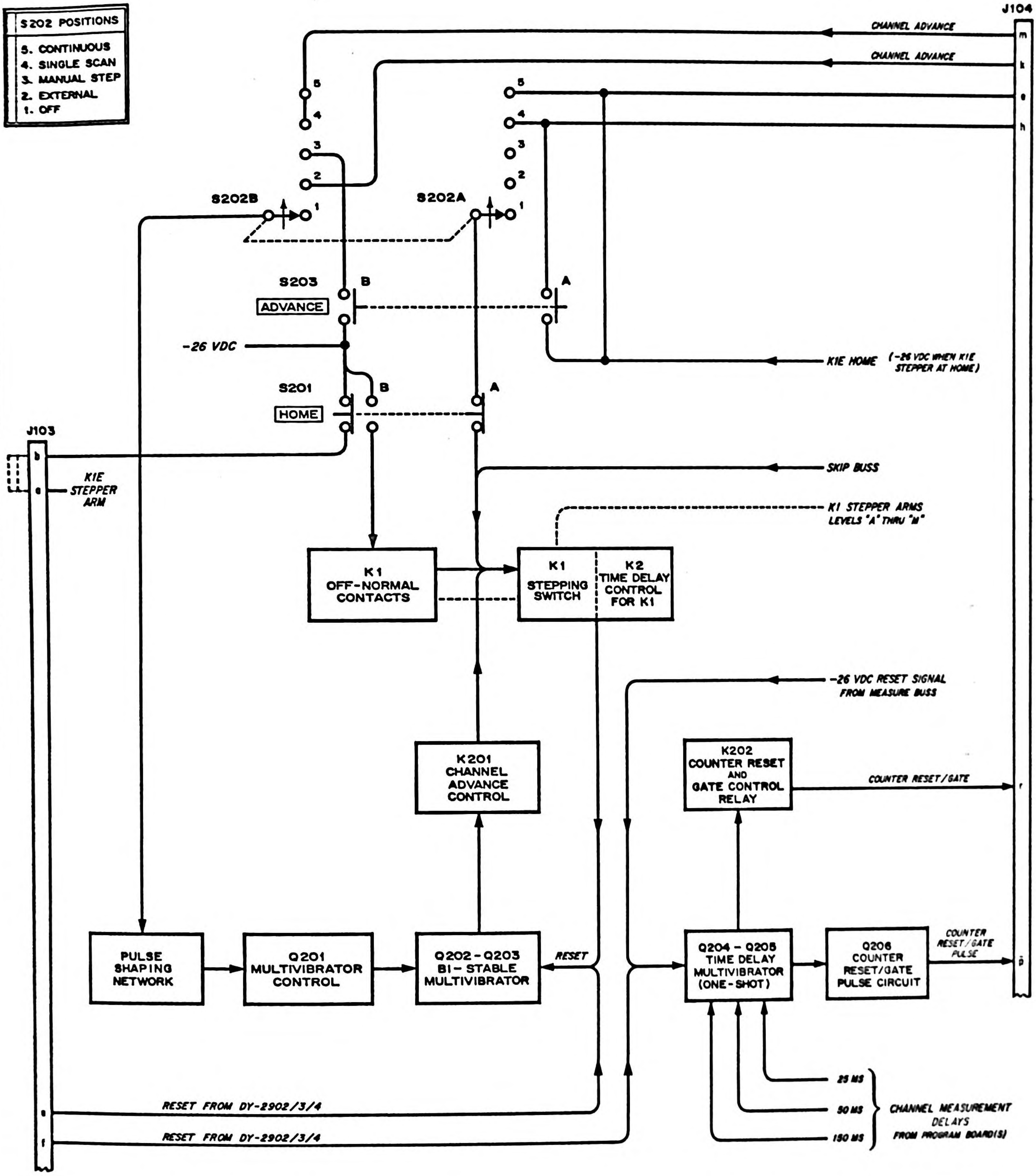

S202 POSITIONS
5. CONTINUOUS
4. SINGLE SCAN
3. MANUAL STEP
2. EXTERNAL
1. OFF
J104
CHANNEL ADVANCE
CHANNEL ADVANCE
m
k
e
h
5
4
3
2
1
S202B
S202A
S203
ADVANCE
B
A
-26 VDC
S201
HOME
B
A
KIE HOME
(-26 VDC WHEN KIE STEPPER AT HOME)
J103
b
a
KIE STEPPER ARM
SKIP BUSS
KI STEPPER ARMS LEVELS "A" THRU "M"
K1 OFF-NORMAL CONTACTS
K1 STEPPING SWITCH
K2 TIME DELAY CONTROL FOR K1
-26 VDC RESET SIGNAL FROM MEASURE BUSS
K201 CHANNEL ADVANCE CONTROL
K202 COUNTER RESET AND GATE CONTROL RELAY
COUNTER RESET/GATE
r
PULSE SHAPING NETWORK
Q201 MULTIVIBRATOR CONTROL
Q202-Q203 BI-STABLE MULTIVIBRATOR
RESET
Q204 - Q205 TIME DELAY MULTIVIBRATOR (ONE-SHOT)
Q206 COUNTER RESET/GATE PULSE CIRCUIT
COUNTER RESET/GATE PULSE
p
25 MS
50 MS
150 MS
CHANNEL MEASUREMENT DELAYS FROM PROGRAM BOARD(S)
e
RESET FROM DY-2902/3/4
f
RESET FROM DY-2902/3/4

FIGURE 3.2. FUNCTIONAL BLOCK DIAGRAM OF DY-2901 INPUT SCANNER CONTROL CIRCUIT

via the J103 pins c and d interlocks. When K1 energizes, its B contacts close to the normally-open side, connecting -26 vdc to energize K2. As K2 energizes, the holding voltage for K1 (supplied through the normally-closed contacts of K2) is removed, and K1 de-energizes. When K1 de-energizes, K2 also de-energizes. (Note: When K2 de-energizes, a positive-going pulse is coupled through CR2 to binary, Q202-Q203. This pulse has a function only when the stepping switch is off its home position, and therefore, will not be discussed at this point.)

As K1 de-energizes, the stepper arm is mechanically advanced to the first channel position, brightening that channel's selector lamp and connecting the channel input data to the external measuring equipment. At the same time, the identification code for that channel is connected to the external coupler or recording device.

When the stepping switch reaches the first channel position (assuming that channel's selector switch has not been positioned to skip that channel's input), the -26 vdc on its level E arm is coupled via the measure buss to the one-shot multivibrator (Q204 and Q205). This signal causes Q204 to turn on (Q205 cuts off) and K202 to energize. When K202 energizes, its B contacts close to the normally-open side, providing a ground through pin r of J104 to reset an external counter in the system.

After a time delay, determined by the position of a shorting pin in section B of the program board, the multivibrator re-flips, de-energizing K202, and removing the ground from pin r of J104. This opens the counter gate and allows the input data to be counted.

The Q206 transistor circuit is operated by the time-delay multivibrator and acts as an electronic switch to provide a fast, low-noise pulse at pin p of J104. When the time delay multivibrator flips to its unstable state, Q206, which normally conducts, cuts off and provides a negative-going output signal. After a delay time, the multivibrator re-flips and Q206 turns on again, providing a positive-going output signal. This pulse can be used as a reset/gate signal in some applications, in place of the contact closure at K202B.

After the data on the first channel has been scanned, a negative-going channel advance signal must be received at pin m (or f) of J104 before the scanner will advance to the second channel position. When this signal is received, it is applied through the mode selector switch (S202B) to the base of transistor Q201, turning it on. When Q201 conducts, its collector drops and causes the bi-stable multivibrator, consisting of Q202 and Q203, to flip so that Q203 begins conducting. When Q203 conducts, relay K201 energizes, allowing -26 vdc to be channeled through its B contacts to energize K1 again. K1 and K2 then go through the same energizing and de-energizing sequence as previously described. When K2 de-energizes this time, the positive-going pulse coupled through CR2 re-flips the bi-stable multivibrator, causing K201 to de-energize, and preventing K1 from being energized again before the next channel advance signal is received. This cycle is repeated until all data positions have been scanned. The stepper arm then returns to the home position and the scanning cycle stops.

When operating in the CONTINUOUS mode, a scan cycle is automatically initiated by a -26 vdc signal from the K1E stepper arm each time it reaches the home position. The cycle is then continued from channel to channel by negative-going channel advance signals received at pin m of J104.

In the MANUAL STEP mode the scanner is advanced one position each time the ADVANCE push button is momentarily depressed. The channel advance signal in this case is provided by momentarily connecting -26 vdc through the ADVANCE push button to the K1 control circuitry.

In the EXTERNAL position the scanner is advanced one position each time a negative-going signal is applied to pin k of J104.

If a particular channel selector switch is set to skip a channel position, the -26 vdc on the K1E stepper arm (when at that channel position) will be coupled via the skip buss to energize K1, and the scanner will step to the next channel. No measure command (reset/gate signal) can be generated in this case, since the measure buss will be disconnected from the -26 vdc.

If the HOME push button is held depressed at any time during a scan cycle, -26 vdc will be continuously applied through the K1 off-normal contacts to repeatedly energize K1 and K2. When the scanner reaches the home position, the off-normal contacts will be mechanically moved to the normal position, removing the -26 vdc from K1, and the scanner will stop.

3.3 PROGRAM BOARDS

The program board in each of the DY-2901/2/3/4 Scanners is similar and contains two separate programming sections. Section A is used to program contact closures for external operating functions at each channel position, and section B is used to program measurement time delays for the system at each channel position. When more than one scanner is used in a system, their program boards are interconnected as shown in Figure 3.3, pg. 3-6. The contact closures from sections A are routed to the external equipment via the last scanner used in the series, whereas the measurement time delays from each scanner are routed to the control circuit in the DY-2901.

Referring to Figure 3.3 and to the schematic diagram of the program board circuits, as a scanner steps from channel-to-channel, the K1J and K1H stepper arms are connected to successive channel positions on the program board, sections A and B, respectively. The K1J stepper arms are tied to the program common through the K301B normally-closed contacts. The program common is normally tied to ground so that as each channel position is scanned, a ground contact closure is provided at all of the programmed positions on that channel. These programmed closures can be used to energize relays or other external functions as desired at each channel position. The actual programming is accomplished by inserting diode pins and/or shorting pins in the program board at selected positions. If more than one contact closure is desired at a given channel position, it is normally necessary to accomplish the programming with diode pins, instead of shorting pins, in order to prevent functions programmed at one channel from also being programmed at certain other channels. (Refer to para. 2.2.3).

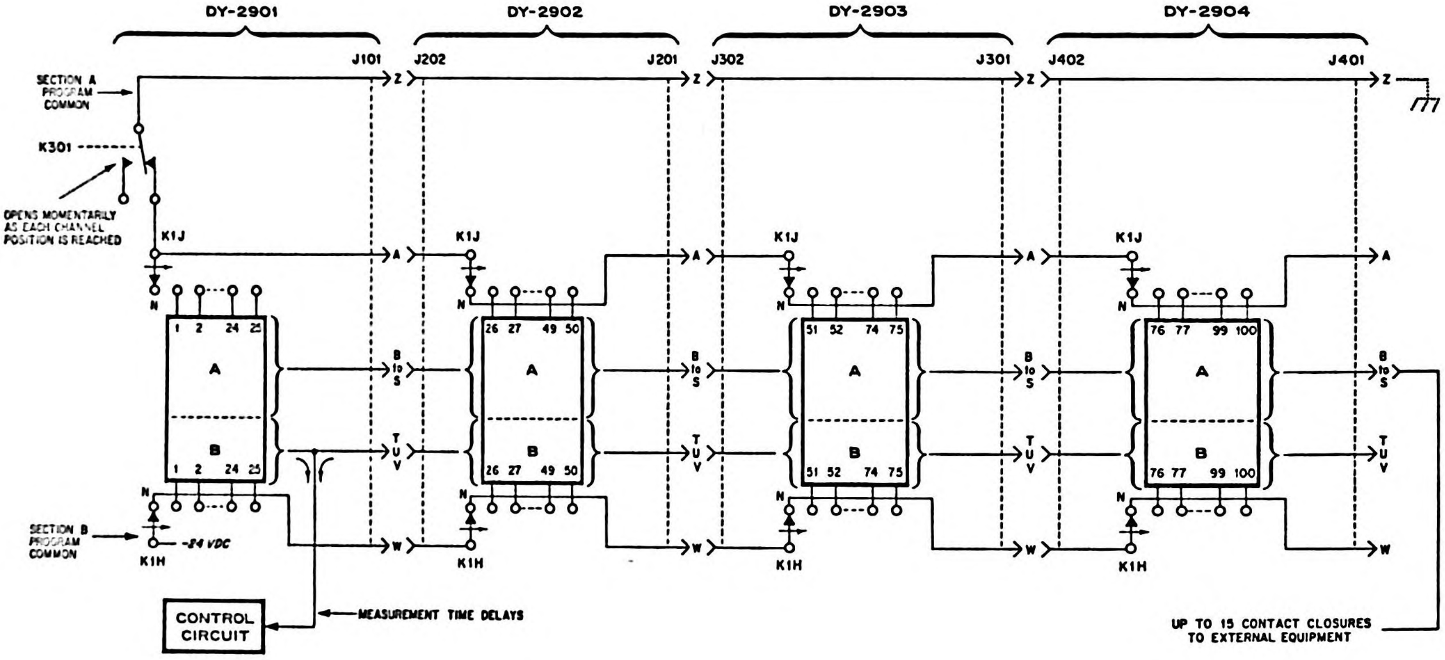


Figure 3.3 DY-2901/2/3/4 Program Board Interconnections.

In the B section of the program board, the K1H stepper arms are connected to -24 vdc. By inserting a shorting pin in the desired time delay position for each channel on the program board, a specific value resistor is connected across R220 in the time-delay multivibrator of the control circuits as each channel is scanned. The resistance selected creates an equivalent impedance in the multivibrator circuit, and thus determines the length of time the multivibrator will remain in its unstable condition after receiving a reset signal from the measure buss. Depending on the position of the shorting pins in the board, delays of 25, 50, 150 or 750 milliseconds can be obtained. Row 1B provides a delay of 25 milliseconds, 2B provides 50 and 3B provides 150. If no pins are inserted, the delay is 750 milliseconds. These standard time delays can be changed if desired by changing the value of resistance associated with each delay. (Refer to para. 2.2.3.)

3.4 OUTPUT DELAY SWITCHING CIRCUIT

When the input data from channel-to-channel consists of different parameters or levels, it is necessary to interrupt the scanner output momentarily in order to allow such instruments as the DY-2401 Digital Voltmeter and DY-2410 Multi-Converter time to be programmed for each measurement. Otherwise, if the data is applied before the instrument has time to be programmed for the measurement, the instrument may be driven out-of-range by the data. The operation of this circuit is described below (refer to Figure 4.7).

When relay K201 in the control circuit energizes and connects -26 vdc to the stepping switch, -26 vdc is also connected to interruptor relays K301 and K302. When K301 energizes, its B contacts open up the stepper arm circuit to the A section of the program board, and connect pin Z to pin d of J101 to provide an overload reset signal to the DY-2401. The A contacts of K301 route -26 vdc to keep K302 energized. Energizing K302 disconnects the input data from the external measuring equipment, and also shorts pins 2 and 3 of the OHMS connector (J113) to prevent the DY-2410 from seeing an open circuit and going out-of-range (infinity).

When K1 steps and K201 de-energizes, K301 also de-energizes, disconnecting the -26 vdc from K302 and connecting J101, pin Z, to the stepper arm for section A of the program board. If rows 1A or 2A have a programming pin inserted at the channel position, then programming relay K304 or K303, respectively, will be energized. After several milliseconds -- sufficient to allow the external measuring instrument(s) to be programmed -- K302 de-energizes and connects the input data to the proper output connector. If K303 has been programmed, the input data will be channeled to the OHMS connector(J113). If K304 has been programmed, the input data will be channeled single-endedly to the FREQUENCY connector (J109). If neither K303 or K304 have been programmed, the input data will be channeled to the AC-DC connector (J114).

When the HOME push button is held depressed to home the scanner, -26 vdc is channeled through CR308 to keep K301 and K302 energized until the HOME push button is released. This action keeps the output disconnected while the scanner is stepping from channel-to-channel getting home, thereby keeping the output measuring devices from changing ranges, etc.

3.5 DY-2902/3/4 SLAVE SCANNER OPERATION

The DY-2902/3/4 Slave Scanners are similar in operation to the DY-2901, but receive power and controlling signals for their stepping switch circuits from the DY-2901. When one or more slave scanners are connected to the DY-2901, the scanning circuits for these units are interconnected by means of the stepping switch off-normal contacts as shown in Figure 3.4. The action of these contacts determines the sequence in which each scanner's stepping relay operates. The last scanner in the series must have a dummy plug connected to its interconnecting output connector to complete the interlocks for the stepping switch circuits. The operation is as follows:

Initially, the off-normal contacts are in the normal position (stepper arms at home). Each time the channel advance relay, K201, in the DY-2901 energizes, -26 vdc is channeled through the interlocked slave scanners to the K1 stepping switch circuit in the DY-2901. When the DY-2901 stepper arms reach position 25, the -26 vdc on the K1E arm is coupled through diode CR4 to energize the K1 stepping switch in the DY-2902. On the next -26 vdc signal from K201 the DY-2901 scanner steps to its home position, and the DY-2902 stepping switch de-energizes and steps to its first position (26). This causes the off-normal contacts in the DY-2902 to move to the off-normal position, and subsequent signals from K201, instead of being channeled to the DY-2901 stepping switch are channeled to the DY-2902 stepping switch.

When the DY-2902 stepper arms reach position 50, the -26 vdc on the K1E arm is coupled through CR4 to energize the K1 stepping switch in the DY-2903. The DY-2903 then scans its 25 positions and energizes the stepping switch in the DY-2904. When the DY-2904 completes scanning its 25 positions, all scanning stops unless the mode selector switch in the DY-2901 is set for CONTINUOUS operation.

When the HOME push button (S201) is held depressed, the -26 vdc is disconnected from all K1E stepper arms, and successive stepping switches in the DY-2901/2/3/4 sequence will be stepped to the home position by -26 vdc applied through their off-normal contacts.

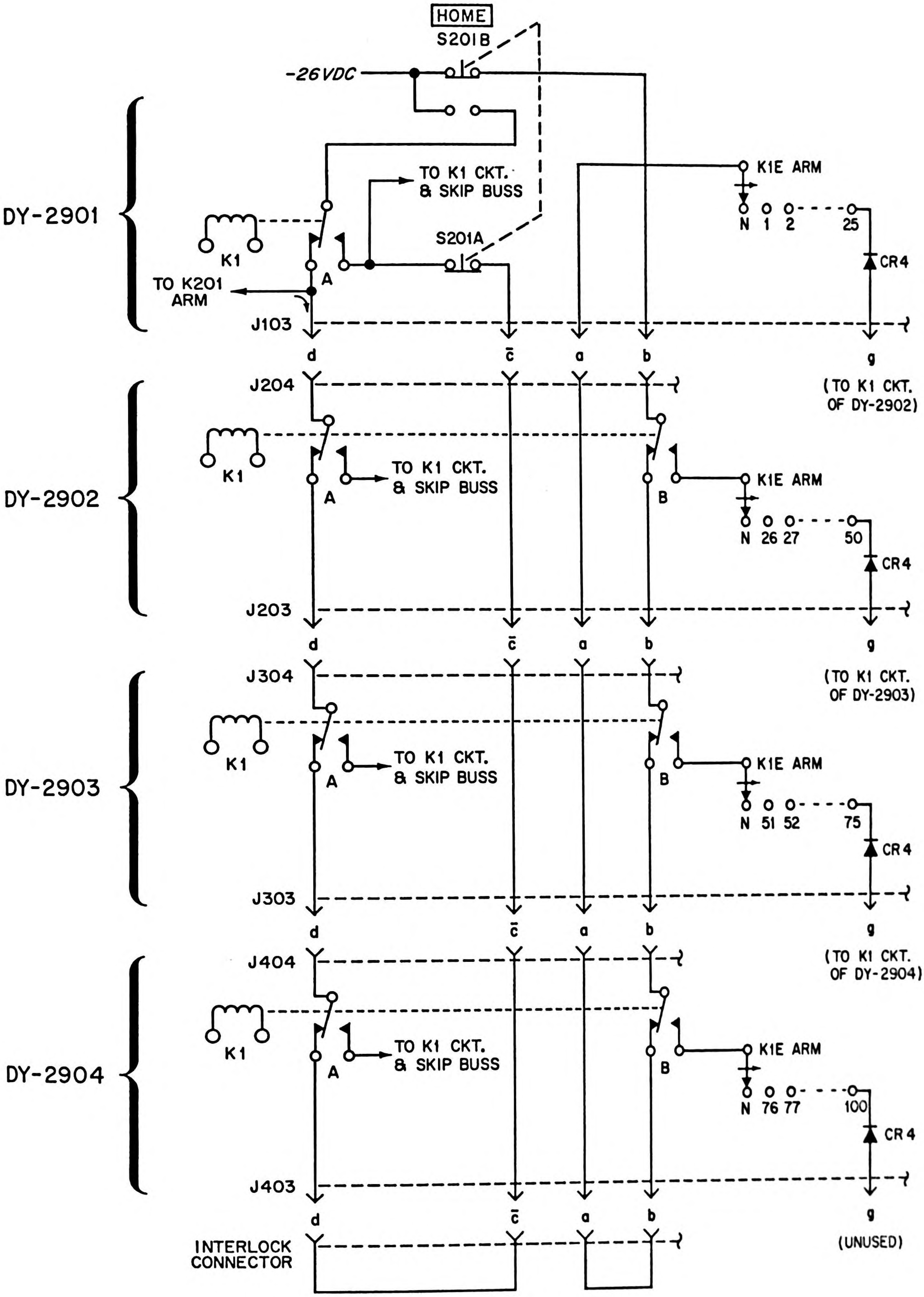


FIGURE 3.4. INTERCONNECTING DIAGRAM OF DY-2901/2/3/4 STEPPING SWITCH OFF-NORMAL CONTACTS (SHOWN IN NORMAL POSITION)

SECTION 4
MAINTENANCE

4.1 GENERAL

The DY-2901/2/3/4 Input Scanners are designed for continuous operation, and with proper care, very little maintenance should be required. One of the most important preventive maintenance procedures that should be followed is periodic lubrication of the stepping switch as described in this section.

If trouble is encountered in getting the scanner(s) to operate properly, the first check to make is to see that the instruments are cabled together properly. It is especially important that the interlocking mating connector supplied be connected to the last scanner used in the series (See Figure 2.2). If the system appears to be cabled properly and still does not operate, check the power supply voltages in the DY-2901, and check to see that system signals, such as the channel advance and reset signals, are present and adequate. The connector pin connection lists in this section should be helpful in tracing signal paths. For further checks, inspect the instrument for signs of mechanical damage, overheating, poor relay or switch contacts, etc.

TABLE 4.1 J101 PIN CONNECTIONS

Connector Type: MS3102A28-21P

Mating Connector: MS3106B28-21S

J101 PIN	DESCRIPTION	INTERNAL DESTINATION
A	Routes section A program common to K1J arm in DY-2902	K301 (N.C.)
B	Contact closures from program board, section A, for external functions	P.B., row A1
C		P.B., row A2
D		P.B., row A3
E		P.B., row A4
F		P.B., row A5
G		P.B., row A6
H		P.B., row A7
J		P.B., row A8
K		P.B., row A9
L		P.B., row A10
M		P.B., row A11
N		P.B., row A12
P		P.B., row A13
R		P.B., row A14
S		P.B., row A15
T	25 ms time delay from DY-2902/3/4	R207
U	50 ms " " " "	R206
V	150 ms " " " "	R205
W	Routes section B program common to K1H arm in DY-2902	K1H (Normal)
X	Spare	
Z	Section A program common for K1J arm	K301B arm
a	Spare	---
b	Spare	---
c	Spare	---
d	Overload reset for DY-2401	K301B (N.O.)
e	Spare	---
f	Spare	---
g	Spare	---
h	Spare	---
j	-26 vdc available for external use	F102
k	Spare	---
m	Spare	---
n	Spare	---
p	Spare	---
r	Counter reset (normally open)	K202B (N.O.)
s	Chassis ground	---

N.O. = Normally open
N.C. = Normally closed
P.B. = Program Board

TABLE 4.2 J103 PIN CONNECTIONS

Connector Type: MS3102A28-21P

Mating Connector: MS3106B28-21S

J103 PIN	DESCRIPTION	INTERNAL DESTINATION
A	Connection for K1F arm in DY-2902	K1F (Normal)
B	Channel I.D. "9" from DY-2902/3/4	A2 (9)
C	" " "8" " "	A2 (8)
D	" " "7" " "	A2 (7)
E	" " "6" " " Units	A2 (6)
F	" " "5" " " digit,	A2 (5)
G	" " "4" " " ten-line only	A2 (4)
H	" " "3" " "	A2 (3)
J	" " "2" " "	A2 (2)
K	" " "1" " "	A2 (1)
L	" " "0" " "	A2 (10)
M	Connection for K1G arm in DY-2902	K1G (Normal)
N	Channel I.D. "9" from DY-2904	A3 (9)
P	" " "8" " "	A3 (8)
R	" " "7" " " & DY-2903	A3 (7)
S	" " "6" " DY-2903 Tens	A3 (6)
T	" " "5" " " & DY-2902 digit,	A3 (5)
U	" " "4" " DY-2902 ten-line only	A3 (4)
V	" " "3" " "	A3 (3)
W	" " "2" " "	A3 (2)
X	" " "1"	A3 (1)
Z	" " "0" " DY-2904	A3 (10)
a	-26 vdc when interlocked with J103b	K1E arm
b	Normally -26 vdc for interlock with J103a	S201B
c	Channel advance interlock	S201A
d	Channel advance interlock	K201B arm
e	Binary reset from DY-2902/3/4	A1 (5)
f	-26 vdc pulse from DY-2902/3/4 to trigger time delay multivibrator	A1 (23)
g	Routes -26 vdc for scan initiation in DY-2902	CR4 anode
h	Spare	---
j	-26 vdc	F102
k	Spare	---
m	5.5 vac for DY-2902/3/4 channel selector lamps	T101 (8)
n		T101 (8)
p	5.5 vac ground reference	---
r		---
s	Chassis ground	---

TABLE 4.3 J104 PIN CONNECTIONS

Connector Type: MS3102A28-21S

Mating Connector: MS3106B28-21P

J104 PIN	DESCRIPTION	INTERNAL DESTINATION
A	Connection from K1F arm via A2, pins 24 & 23 (output for units staircase codes; input-common for other codes)	A2, pin 24
B	Channel I.D. "9" or 4	A2, pin 12
C	" " "8" or 2' BCD	A2, pin 13
D	" " "7" or 2 out	A2, pin 14
E	" " "6" or 1	A2, pin 15
F	" " "5" Ten-line Units	A2, pin 16
G	" " "4" out digit	A2, pin 17
H	" " "3"	A2, pin 18
J	" " "2"	A2, pin 19
K	" " "1"	A2, pin 20
L	" " "0"	A2, pin 11
M	Connection from K1G arm via A3, pins 24 & 23 (output for tens staircase code; input-common for other codes)	A3, pin 24
N	Channel I.D. "9" or 4	A3, pin 12
P	" " "8" or 2' BCD	A3, pin 13
R	" " "7" or 2 out	A3, pin 14
S	" " "6" or 1	A3, pin 15
T	" " "5" Ten-line Tens	A3, pin 16
U	" " "4" out digit	A3, pin 17
V	" " "3"	A3, pin 18
W	" " "2"	A3, pin 19
X	" " "1"	A3, pin 20
Z	" " "0"	A3, pin 11
a	Spare	---
b	Spare	---
c	Spare	---
d	Spare	---
e	-26 vdc when K1E at home	S202A (5)
f	Channel advance for continuous or single scan (small signals only)	S202B (5)
g	+300 volts from -hp- 560A Recorder when used	A3, pin 22
h	Jumpers to J104 e for single scan initiation	S202A (4)
j	-26 vdc	F102
k	Channel advance for external step mode	S202B (2)
m	Channel advance for continuous or single scan	R203
n	Unused (normally ground)	K202B (N.C.)
p	Counter reset pulse (normally about 0 volts)	R213
r	Counter reset (normally open)	K202B (N.O.)
s	Chassis ground	---

N.O. = Normally open
N.C. = Normally closed

TABLE 4.4 J201 PIN CONNECTIONS

Connector Type: MS3102A28-21P

Mating Connector: MS3106B28-21S

J201 PIN	DESCRIPTION	INTERNAL DESTINATION
A	Routes section A program common to K1J arm in DY-2903	K1J (Normal)
B	Contact closures from program board, section A, for external functions	P.B., row A1
C		P.B., row A2
D		P.B., row A3
E		P.B., row A4
F		P.B., row A5
G		P.B., row A6
H		P.B., row A7
J		P.B., row A8
K		P.B., row A9
L		P.B., row A10
M		P.B., row A11
N		P.B., row A12
P		P.B., row A13
R		P.B., row A14
S		P.B., row A15
T	25 ms time delay from DY-2903/4	J202T
U	50 ms " " " "	J202U
V	150 ms " " " "	J202V
W	Routes section B program common to K1H arm in DY-2903	K1H (Normal)
X	Spare	---
Z	Section A program common	J202 Z
a	Spare	---
b	Spare	---
c	Spare	---
d	Overload reset for DY-2401	J202d
e	Spare	---
f	Spare	---
g	Spare	---
h	Spare	---
j	-26 vdc from DY-2901 available for external use	J202j
k	Spare	---
m	Spare	---
n	Spare	---
p	Spare	---
r	Counter reset from DY-2901	J202r
s	Chassis ground	---

N.O. = Normally Open
N.C. = Normally Closed
P.B. = Program Board

TABLE 4.5 J202 PIN CONNECTIONS

Connector Type: MS3102A28-21S

Mating Connector: MS3106B28-21P

J202 PIN	DESCRIPTION	INTERNAL DESTINATION
A	Routes section A program common to K1J arm in DY-2902	K1J arm
B	Connections for routing P.B., section A, contact closures from DY-2901 through the DY-2902.	J201B
C		J201C
D		J201D
E		J201E
F		J201F
G		J201G
H		J201H
J		J201K
L		J201L
M		J201M
N		J201N
P		J201P
R		J201R
S		J201S
T	25 ms time delay to DY-2901 from DY-2902/3/4	J201T & P.B., row B1
U	50 ms " " " " " "	J201U & P.B., row B2
V	150 ms " " " " " "	J201V & P.B., row B3
W	Routes section B program common to K1H arm in DY-2902	K1H arm
X	Spare	---
Z	Section A program common	J201z
a	Spare	---
b	Spare	---
c	Spare	---
d	Overload reset for DY-2401	J201d
e	Spare	---
f	Spare	---
g	Spare	---
h	Spare	---
j	Routes -26 vdc from DY-2901 through the DY-2902	J201j
k	Spare	---
m	Spare	---
n	Spare	---
p	Spare	---
r	Counter reset from DY-2901	J201r
s	Chassis ground	---

P.B. = Program Board

TABLE 4.6 J203 PIN CONNECTIONS

Connector Type: MS3102A28-21P

Mating Connector: MS3106B28-21S

J203 PIN	DESCRIPTION	INTERNAL DESTINATION
A	Connection for K1F arm in DY-2903	K1F (Normal)
B	Channel I.D. "9" from DY-2903/4	J204B
C	" " "8" " "	J204C
D	" " "7" " "	J204D
E	" " "6" " "	J204E
F	" " "5" " " Units digit,	J204F
G	" " "4" " " Ten-line	J204G
H	" " "3" " " only	J204H
J	" " "2" " "	J204J
K	" " "1" " "	J204K
L	" " "0" " "	J204L
M	Connection for K1G arm in DY-2903	K1G (Normal)
N	Channel I.D. "9" from DY-2904	J204N
P	" " "8" " "	J204P
R	" " "7" " " & DY-2903	J204R
S	" " "6" " DY-2903	J204S
T	" " "5" " " Tens digit,	J204T
U	" " "4" ten-line	J204U
V	" " "3" only	J204V
W	" " "2"	J204W
X	" " "1"	J204X
Z	" " "0" from DY-2904	J204Z
a	-26 vdc when interlocked with J203b	J204a
b	Normally -26 vdc for interlock with J203a	K1B (N.C.)
c	Channel advance interlock	J204c
d	Channel advance interlock	K1A(N.C.)
c	Binary reset from DY-2903/4	J204e
f	-26 vdc pulse from DY-2903/4 to trigger time-delay multivibrator	J204f
g	Routes -26 vdc for scan initiation in DY-2903	CR4 anode
h	Spare	---
j	-26 vdc from DY-2901	J204j
k	Spare	---
m >	5.5 vac from DY-2901 to DY-2903/4 channel selector lamps <	J204m
n		J204n
p >	5.5 vac ground reference <	J204p
r		J204r
s	Chassis ground	---

N.O. = Normally open
N.C. = Normally closed

TABLE 4.7 J204 PIN CONNECTIONS

Connector Type: MS3102A28-21S

Mating Connector: MS3106B28-21P

J204 PIN	DESCRIPTION	INTERNAL DESTINATION
A	Connection from K1F (Normal) in DY-2901	K1F arm
B	Channel I.D. "9" from DY-2902/3/4	A2, pin 14, & J203B
C	" " "8" " "	A2, pin 16, & J203C
D	" " "7" " "	A2, pin 18, & J203D
E	" " "6" " " Units digit,	A2, pin 20, & J203E
F	" " "5" " " ten-line	A2, pin 10, & J203F
G	" " "4" " " only	A2, pin 8, & J203G
H	" " "3" " "	A2, pin 6, & J203H
J	" " "2" " "	A2, pin 4, & J203J
K	" " "1" " "	A2, pin 2, & J203K
L	" " "0" " "	A2, pin 12, & J203L
M	Connection from K1G (Normal) in DY-2901	K1G arm
N	Channel I.D. "9" from DY-2904	J203N
P	" " "8" " "	J203P
R	" " "7" " " & DY-2903	J203R
S	" " "6" " DY-2903	J203S
T	" " "5" " " & DY-2902 Tens digit,	J203T & A3, pin 7
U	" " "4" " DY-2902 ten-line	J203U & A3, pin 8
V	" " "3" " " only	J203V & A3, pin 9
W	" " "2" " "	J203W & A3, pin 10
X	" " "1"	J203X & A3, pin 1
Z	" " "0" from DY-2904	J203Z & A3, pin 2
a	-26 vdc when J203a & b are interlocked	J203a
b	Normally -26 vdc for interlock	K1B O.N. arm
c	Channel advance interlock	J203c
d	Channel advance interlock	K1A O.N. arm
e	Binary reset from DY-2902/3/4	CR2 cath. & J203e
f	-26 vdc pulse from DY-2902/3/4 to trigger time delay multivibrator	J203f & Meas. Buss.
g	Routes -26 vdc from DY-2901 for scan initiation in DY-2902	CR5 cathode
h	Spare	---
j	-26 vdc from DY-2901	J203j
k	Spare	---
m	5.5 vac from DY-2901 to DY-2902/3/4 channel selector lamps	J203 m & R1-R25
n		J203 n & R1-R25
p	5.5 vac ground reference	J203 p
r		J203 r
s	Chassis ground	---

O.N. = Off Normal

4.2 LUBRICATING THE STEPPING SWITCH

Stepping switches are designed for long life; as with any running mechanism, they require lubrication according to the amount of use. The switches are lubricated at the factory; after the first 30,000 revolutions they should be lubricated again, but only at 150,000-revolution intervals thereafter. If the switch is used very little, lubrication is recommended at six-month intervals. The chart and procedure gives explicit details for lubrication. The lubricants required are contained in the lubrication kit mounted on the instrument chassis. Attention to this detail will result in long satisfactory service.

Points 1 to 8. Apply Blended Lubricating Oil Spec. 5684 (blended mineral- and paraffin-base oils) as follows:

1, 2	One dip at each end of switch shaft.
3	One dip to each of the yoke bearings.
4, 5, 6	One-half dip to pawl bearing (4). Spread the remainder through the coils of pawl spring (5) and its eyelets, and through the coils of driving spring (6).
7, 8	Small amount to interrupter spring buffer (7) and indicator wheel off-normal (8).

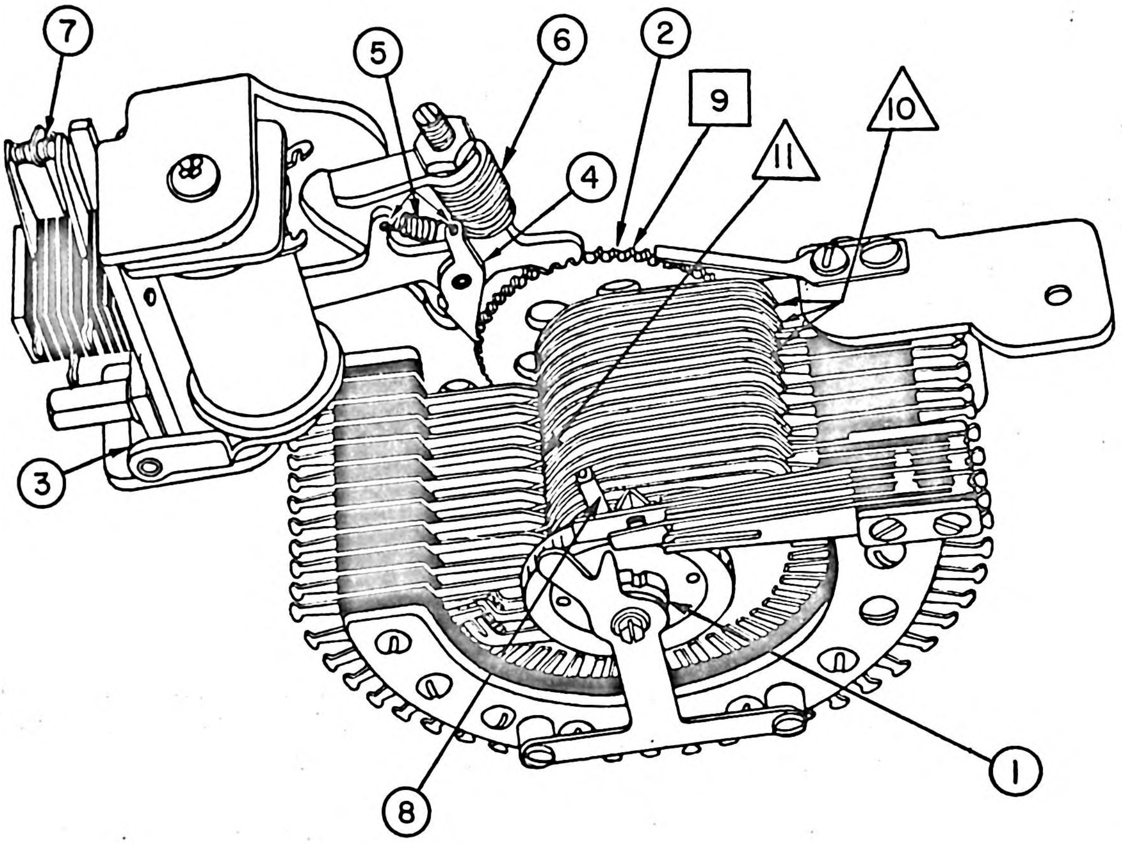
9 Apply two dips of Switch Lubricant Spec. 5232-C (blended oil and deflocculated graphite) to ratchet (9), spreading the lubricant evenly over all of the teeth.

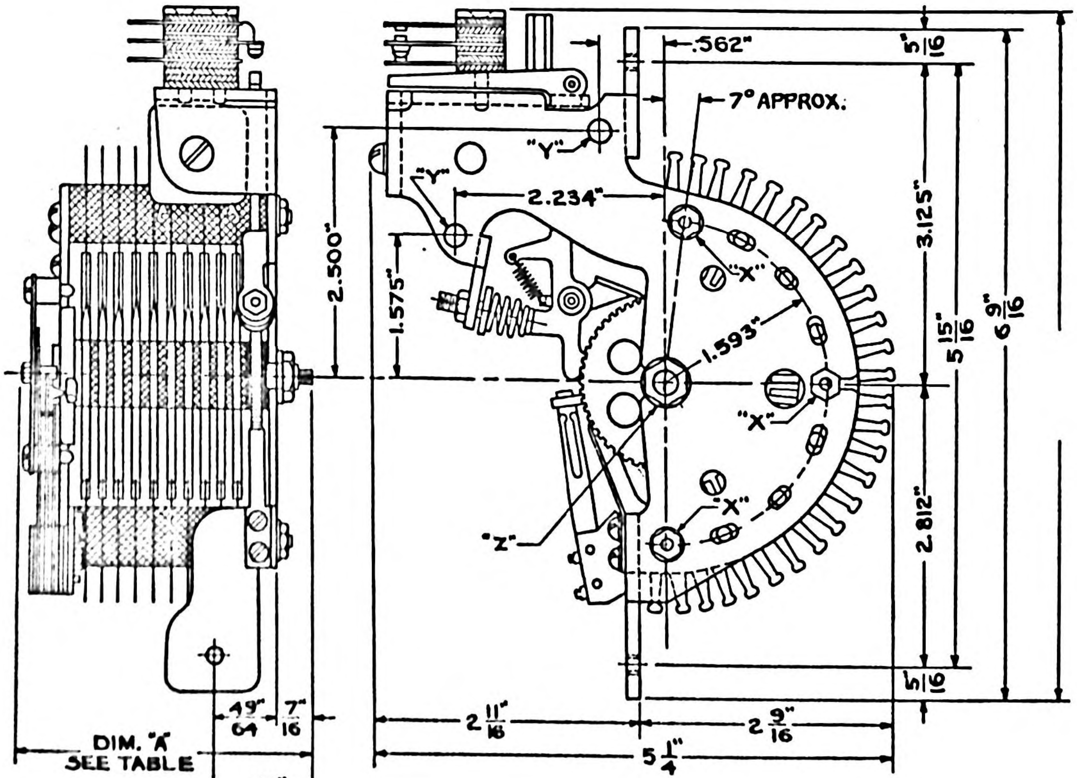
10, 11. Apply Watch Oil Spec. 5228 (highly refined fish oil) as follows:

10	One-third dip between the tips of each pair of wiper springs with the wipers standing off the bank. Rotate the switch and repeat for the other sets of wipers.
11	One dip between each wiper pair in the path of the brush spring pairs.

Rotate the switch to distribute the lubricants. Wipe off excess lubricant. Do not over-lubricate.

TYPE 45




.562"
5/16
7° APPROX.
"Y"
"Y"
2.234"
2.500"
1.575"
"X"
1.593"
"X"
"X"
"Z"
3.125"
5 15/16
6 9/16
2.812"
5/16
49/64"
7/16"
DIM. "A"
SEE TABLE
1 13/64"
2 11/16"
2 9/16"
5 1/4"

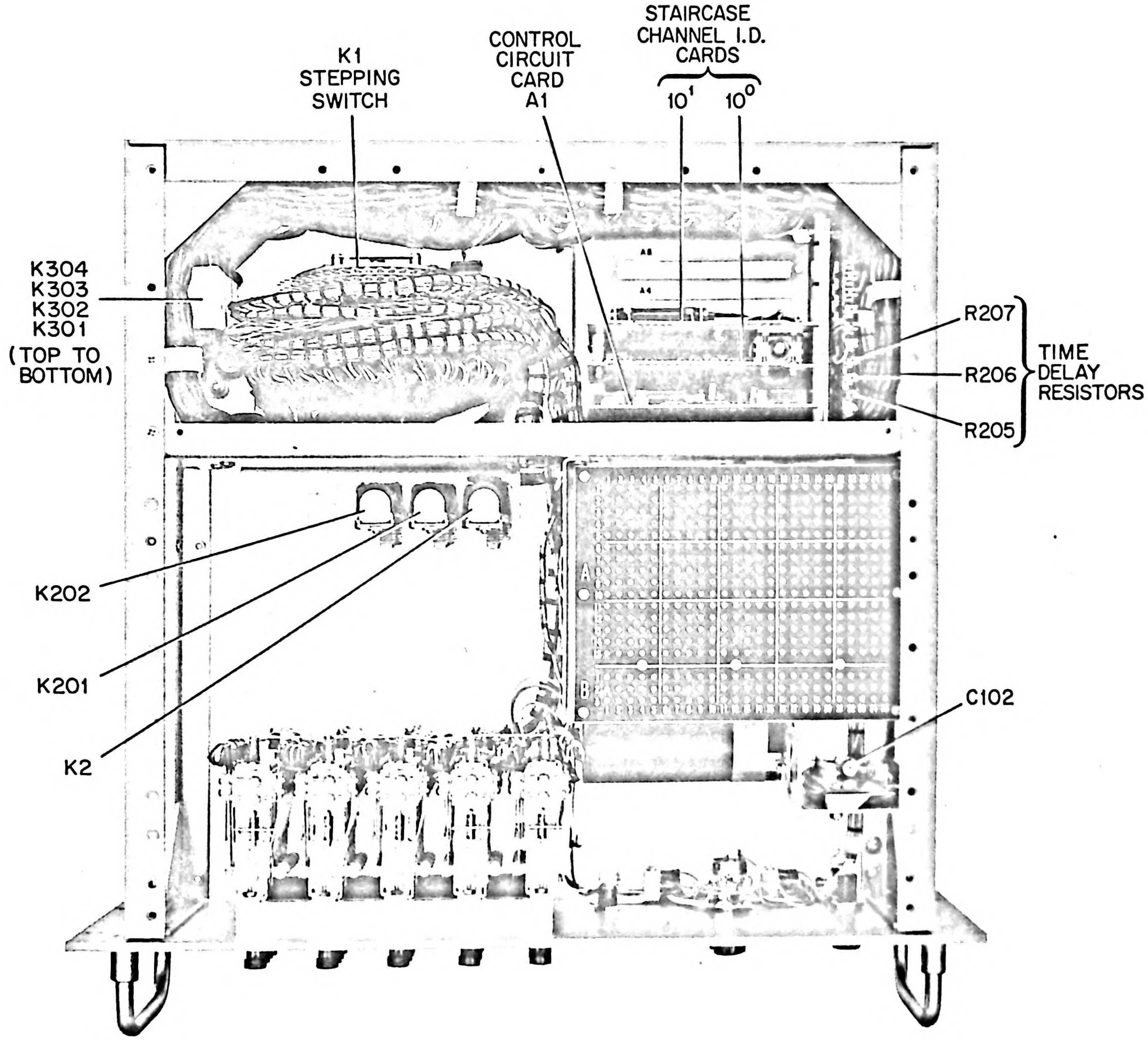


FIGURE 4.1. DY-2901 TOP INTERNAL VIEW

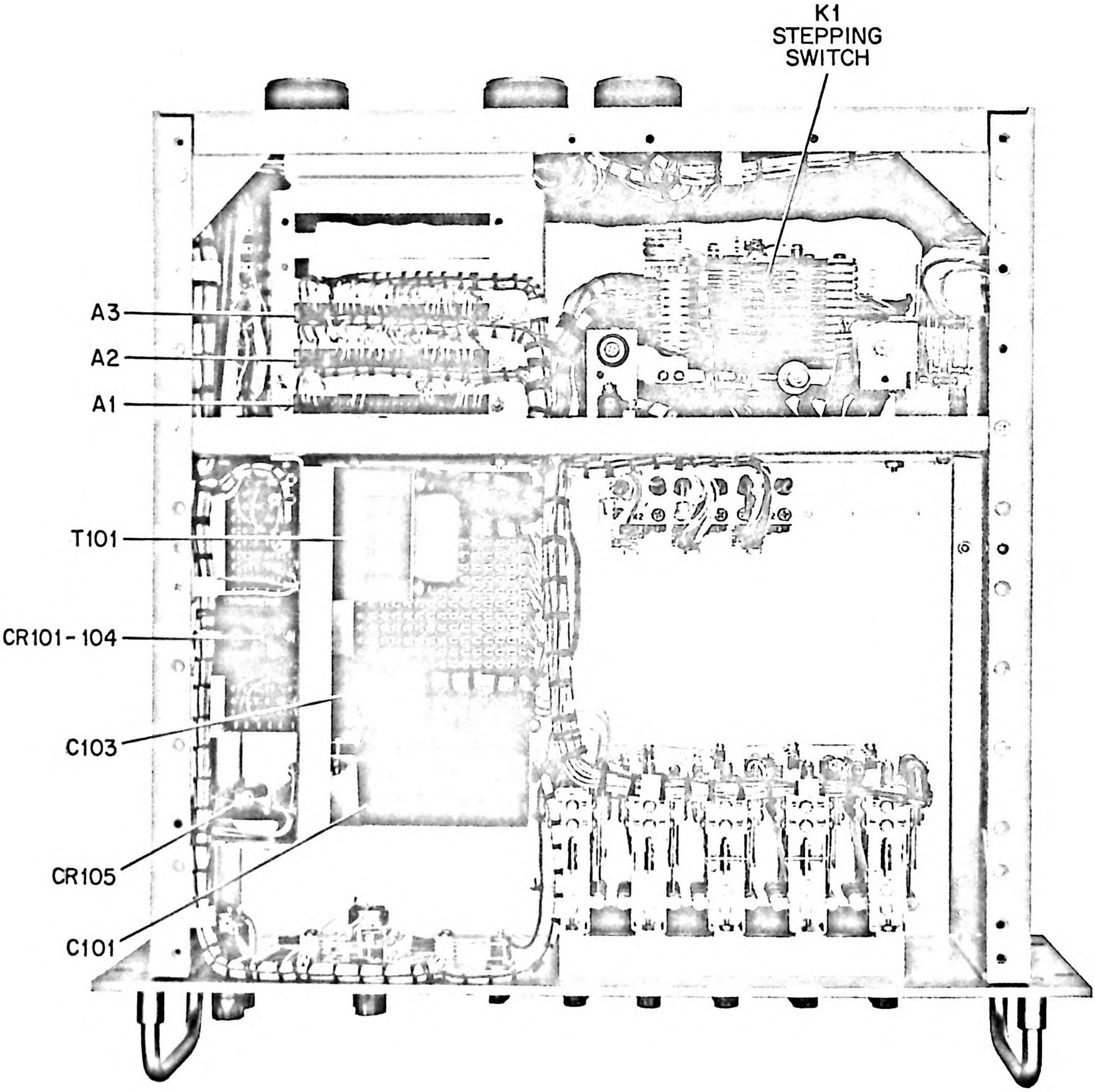


FIGURE 4.2. DY-2901 BOTTOM INTERNAL VIEW

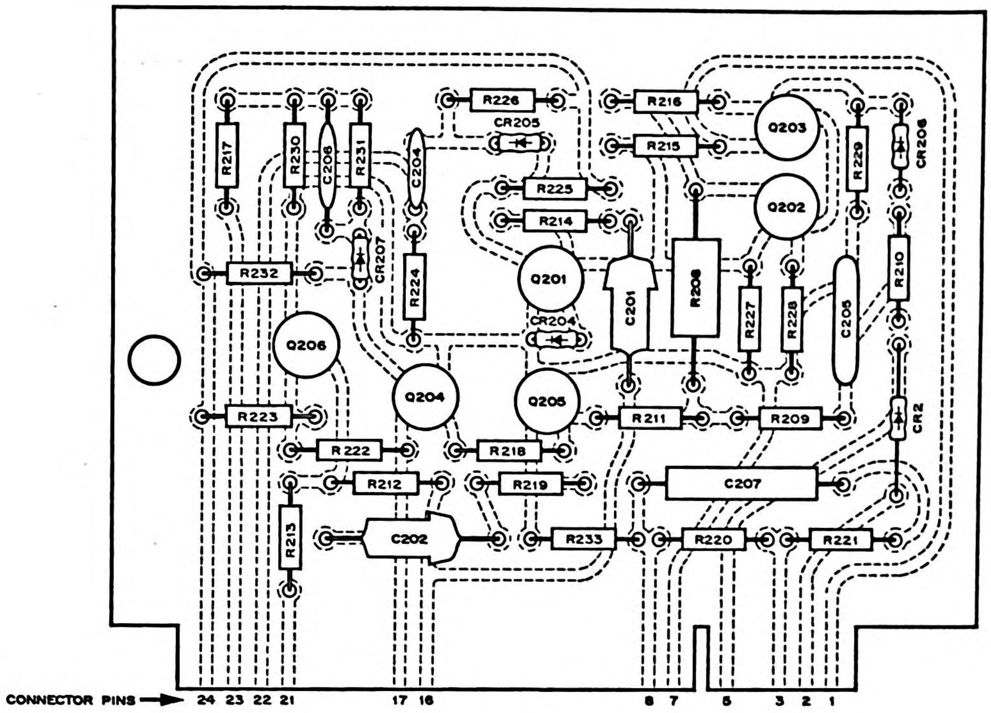


FIGURE 4.3. DY-2901 CONTROL CIRCUIT PLUG-IN CARD

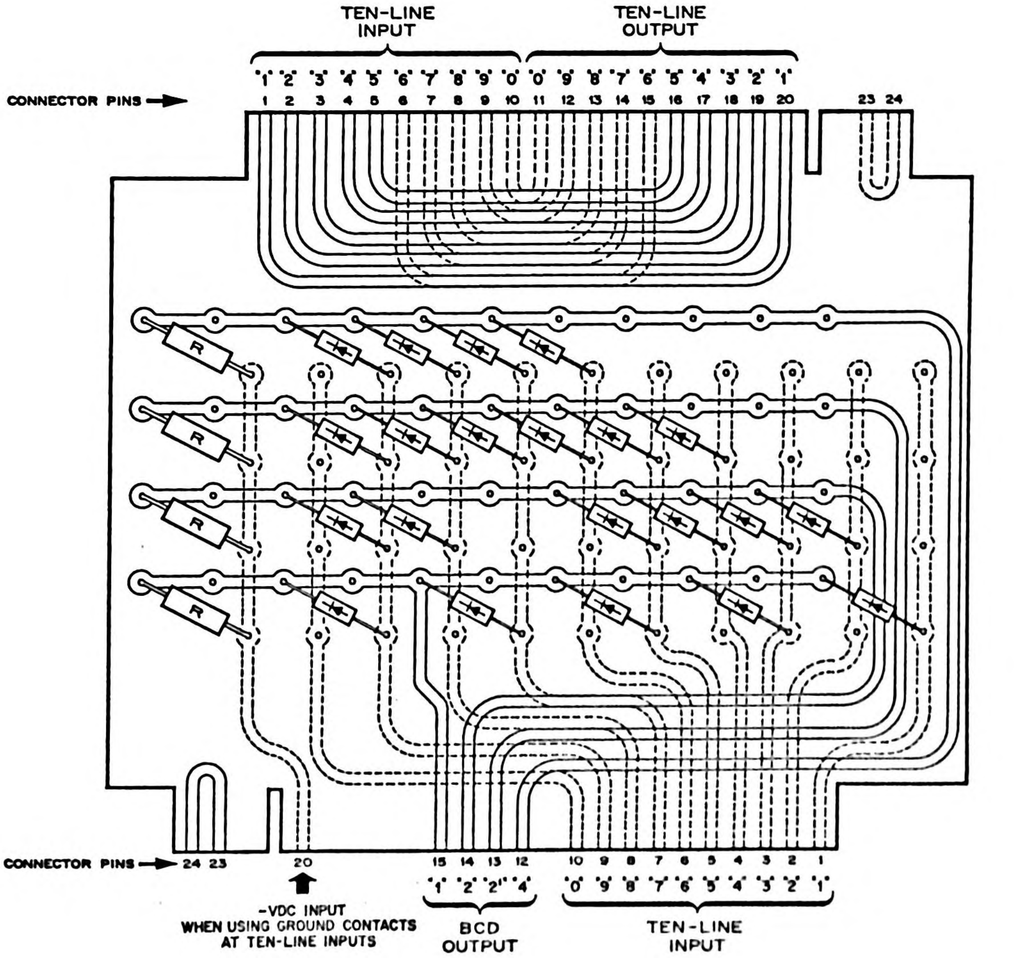


FIGURE 4.4. CHANNEL IDENTIFICATION CODING CARD FOR 10-LINE AND 4-2'-2-1 BCD

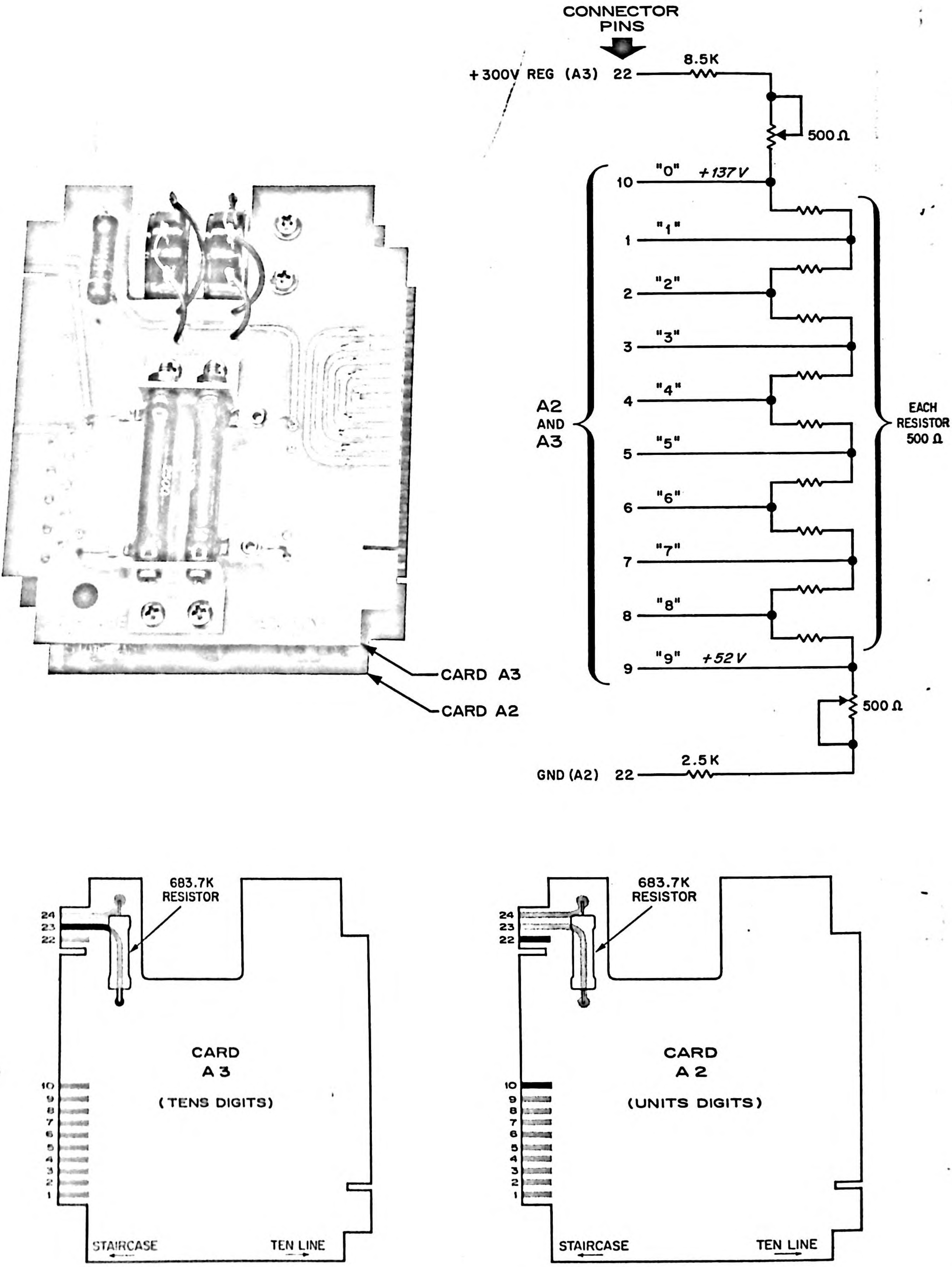


FIGURE 4.5. CHANNEL IDENTIFICATION CODING CARDS FOR STAIRCASE CODES

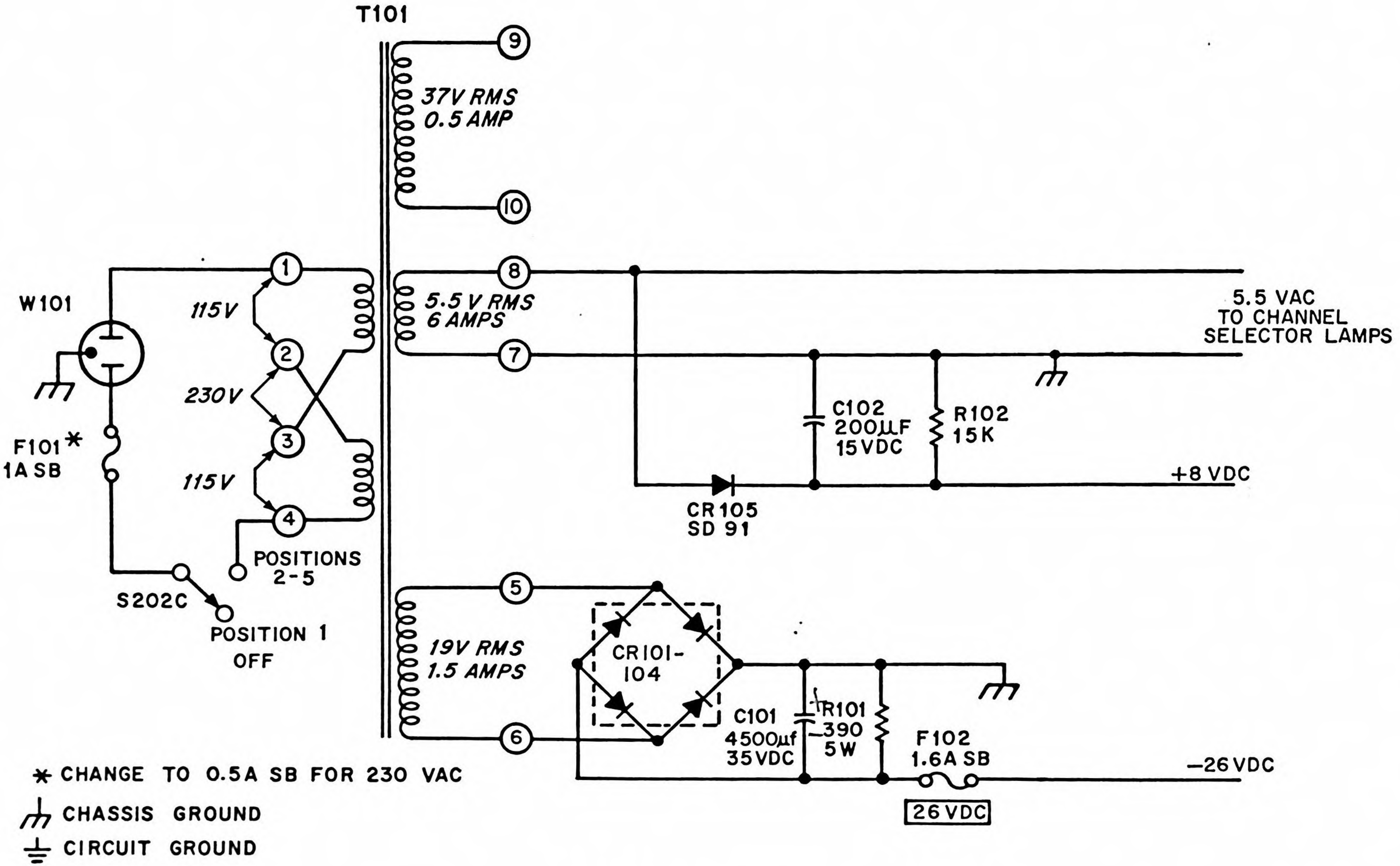


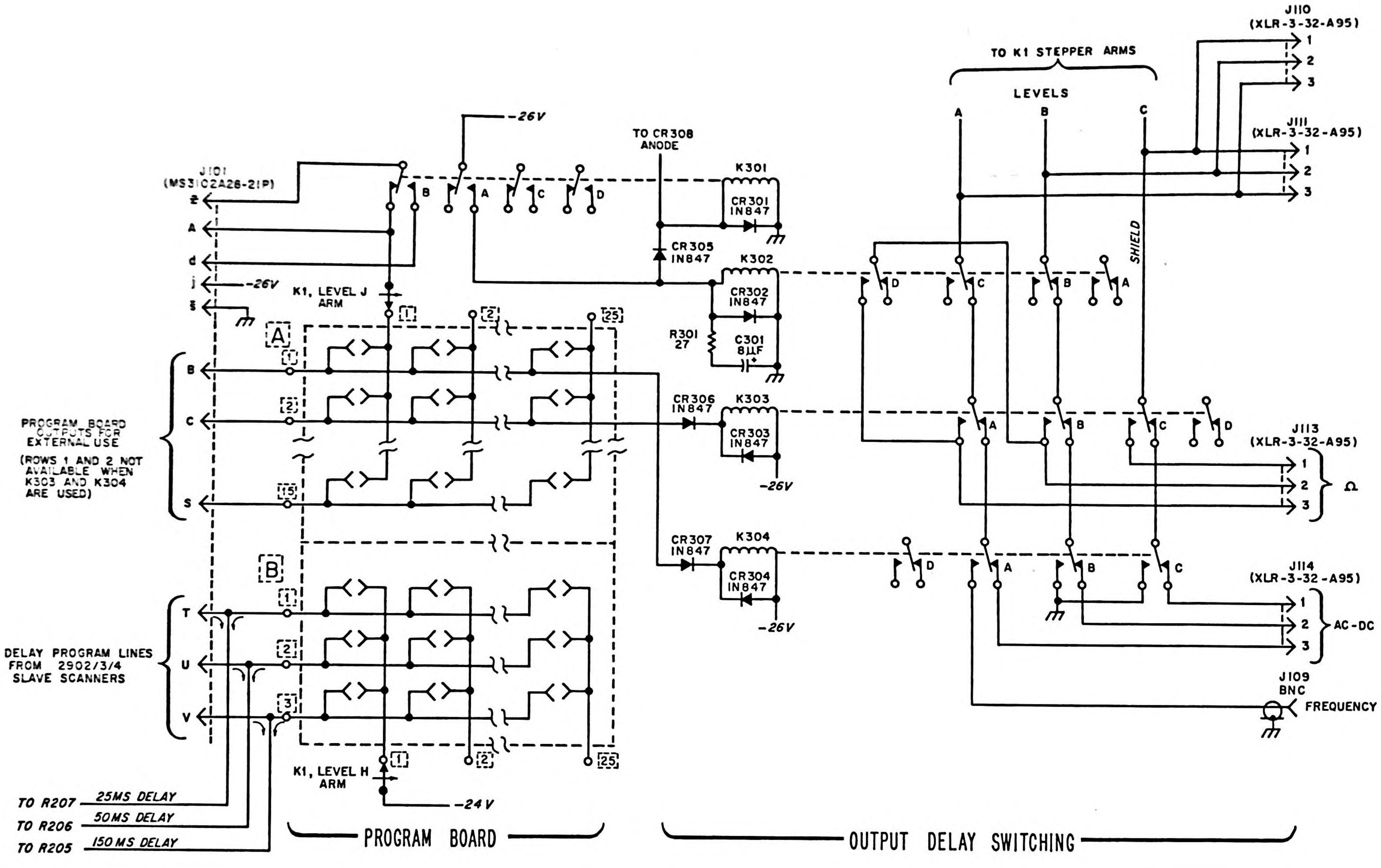
FIGURE 4.6

DY-2901 INPUT SCANNER

POWER SUPPLY

SERIALS PREFIXED 116

B2901-1001



NOTE:

⏚ = CHASSIS GROUND

⏚ = CIRCUIT COMMON

FIGURE 4.7

MODEL DY-2901 INPUT SCANNER

OUTPUT DELAY SWITCHING AND PROGRAMMING BOARD SECTION

SERIALS PREFIXED 116

C2901-1004

Figure 4.8 DY-2901 Input Scanner Control Circuit

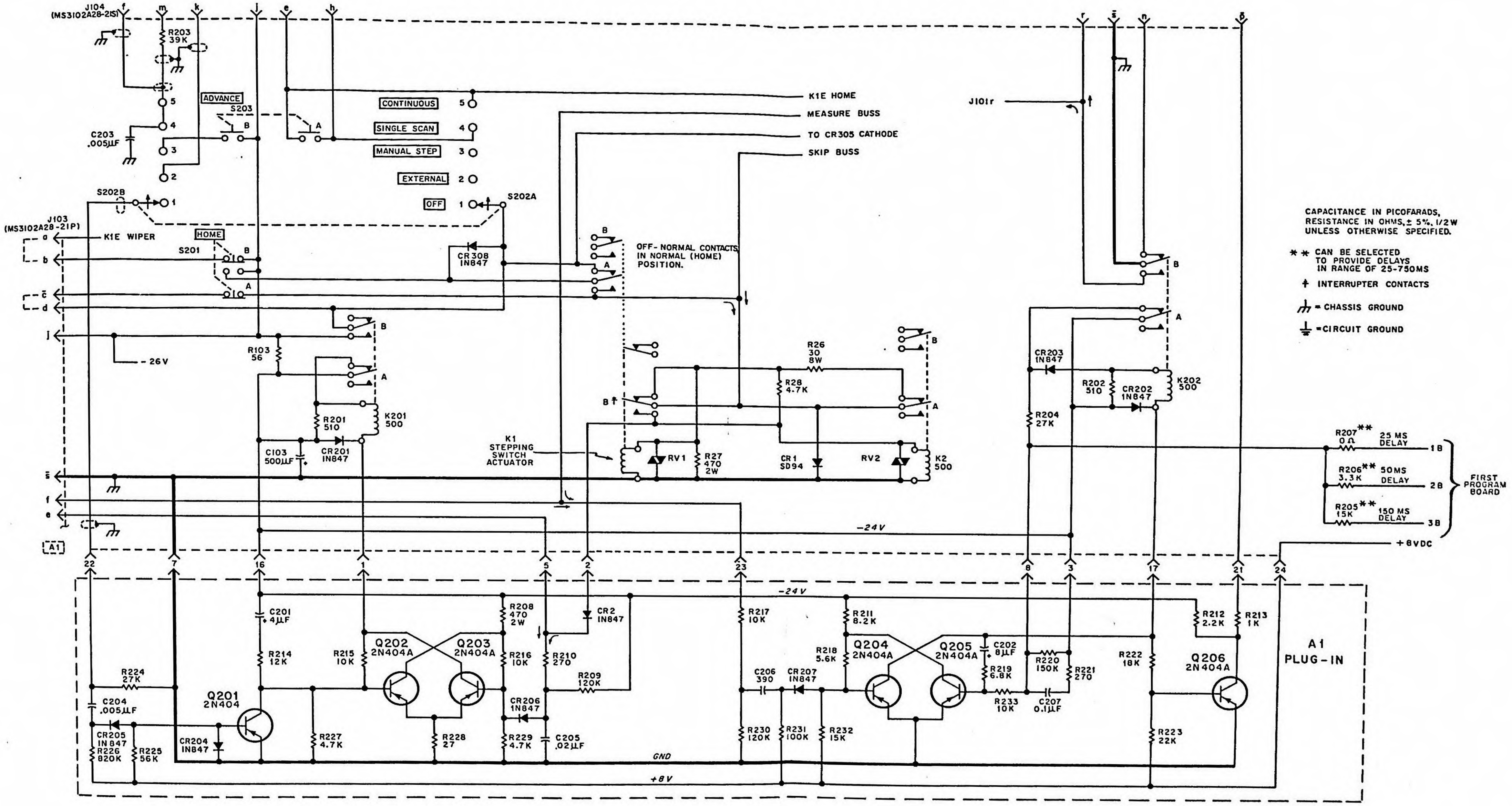


FIGURE 4.8

DY-2901 INPUT SCANNER

CONTROL CIRCUIT

SERIALS PREFIXED 116

D2901-1002

Figure 4.9 DY-2901 Input Scanner
Stepping Switch Circuits

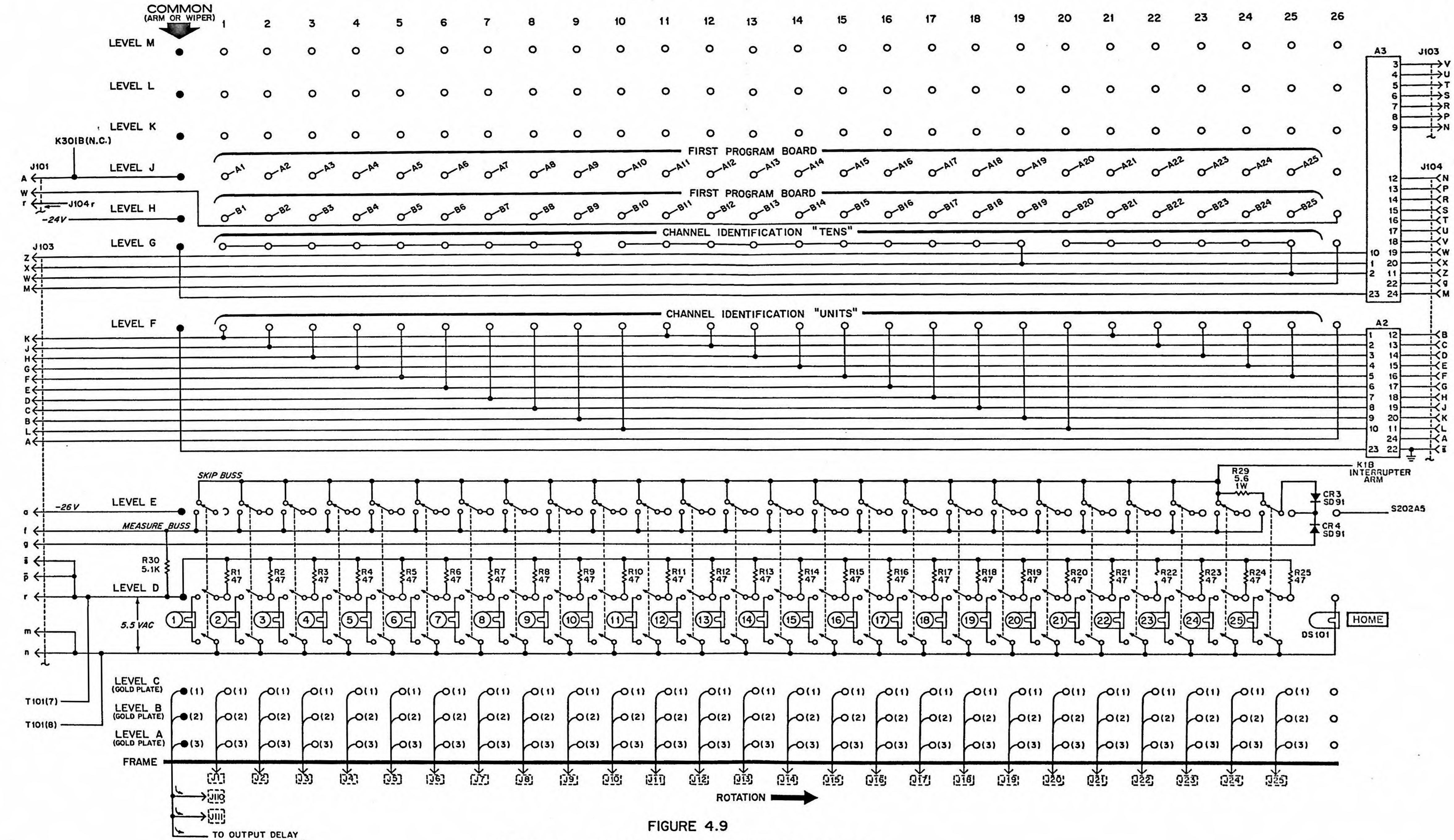


FIGURE 4.9

MODEL DY-2901 INPUT SCANNER

STEPPING SWITCH CIRCUITS

SERIALS PREFIXED 116-

D2901-1003

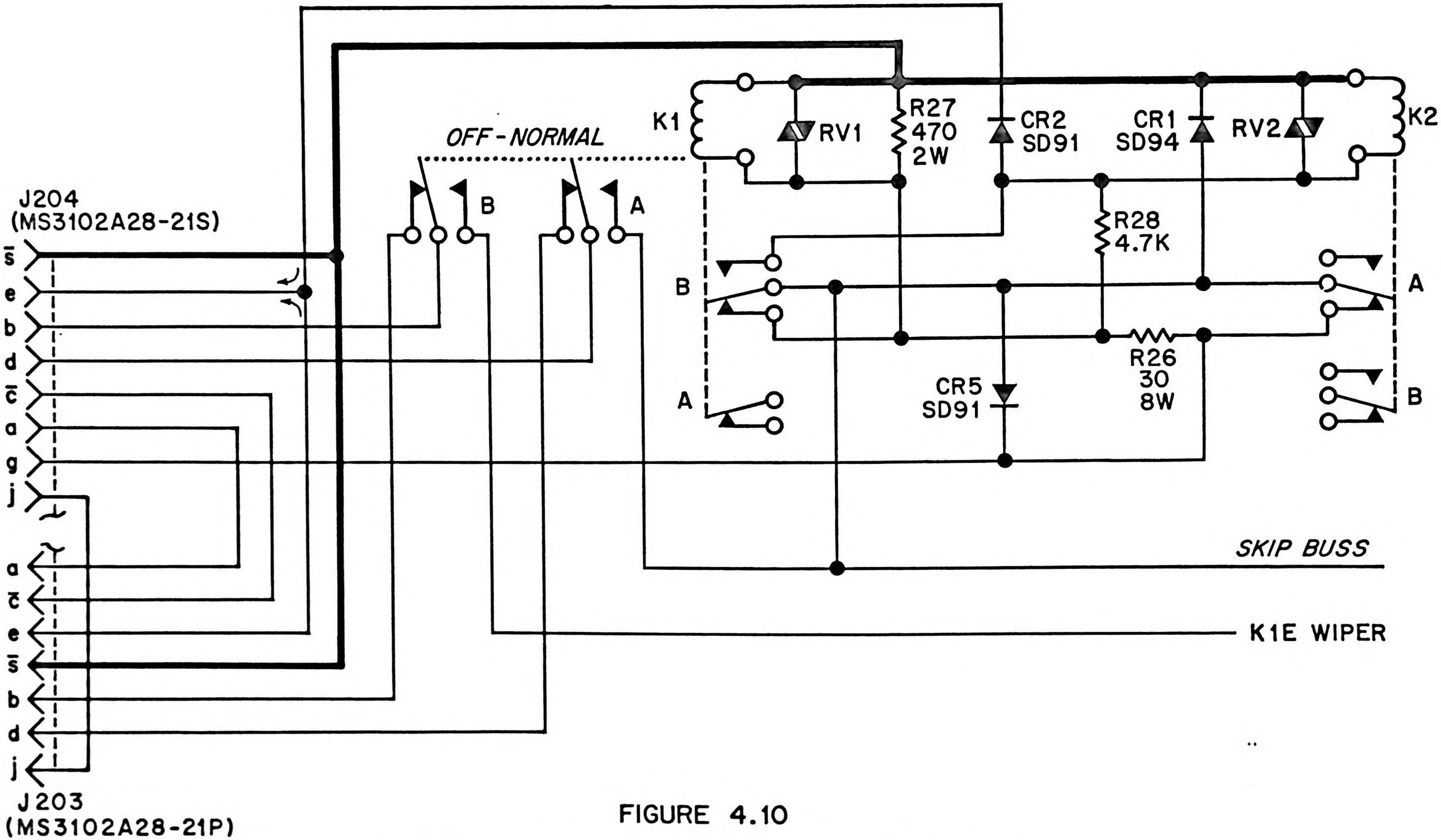


FIGURE 4.10

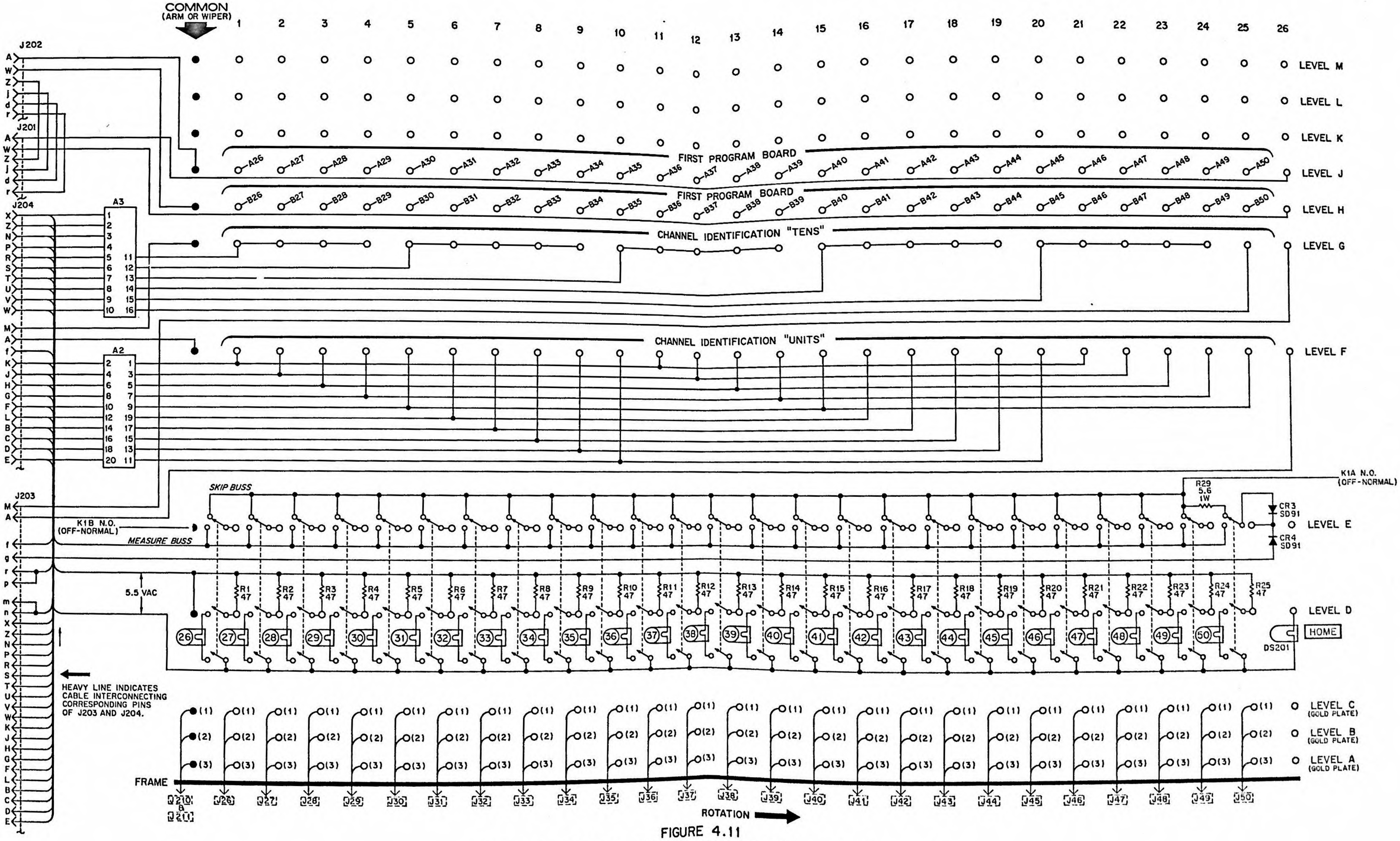
DY-2902/3/4 INPUT SCANNER

STEPPER CONTROL CIRCUIT

SERIALS PREFIXED 116

A2902-1001

Figure 4.11 DY-2902/3/4 Input Scanner Stepping Switch Circuits



HEAVY LINE INDICATES CABLE INTERCONNECTING CORRESPONDING PINS OF J203 AND J204.

FIGURE 4.11

MODEL DY-2902/3/4 INPUT SCANNERS

STEPPING SWITCH CIRCUITS

SERIALS PREFIXED 116

D2902-1002

SECTION 5
TABLE OF REPLACEABLE PARTS

Any changes in the Table of Replaceable Parts will be listed on a Production Change sheet at the front of this manual.

If a part in the Table has only a Dymec stock number, it is a special part that can be obtained only from Dymec. If a part has another manufacturer's stock number, it can be obtained directly from that manufacturer. Manufacturers' code letters are listed on the last page. In most cases parts provided by manufacturers other than those listed can be used if they have the same electrical and physical characteristics, and are equal or better in quality.

To order a part from Dymec, give the instrument model and serial numbers, the description of the part, and the Dymec stock number.

As noted on the schematic diagrams, the electrical values of certain parts are selected to compensate for variations in other components, wiring capacitance, etc. In some instruments a selected part may be omitted (e.g. a selected resistor might be a wire or an open circuit). The schematic diagram gives the nominal value of these parts. When replacing, use the original value of the replaced part.

REFERENCE DESIGNATOR	DESCRIPTION	DYMEC STOCK NO.	*MFR. CODE	MFR. PART NO.	QTY.	†1-YR. SPA.		
A1	Connector, printed circuit, 24-pin, (Key 6)	2535-0059	95354	SD624S-P6	1	1		
A2,3	Connector, printed circuit, 24-pin, (Key 21)	2535-0060	95354	SD624S-P21	2	1		
C101	Capacitor: fixed, electrolytic, 4500uf, 35V	1010-0030	56289	32D314	1	1		
C102	Capacitor: fixed, electrolytic, 200uf, 15V	1010-0022	56289	TE1164	1	1		
C103	Capacitor: fixed, electrolytic, 500uf, 75V	1013-0008	56289	D27345-852-J	1	1		
C201	Capacitor: fixed, electrolytic, 4uf, -15 +20%, 60V	1011-0001	21520	PP4B60A1	1	1		
C202	Capacitor: fixed, electrolytic, 8uf, -15 +20%, 30V	1011-0002	21520	PP8B30A1	2	1		
C203, 204	Capacitor: fixed, ceramic, .005uf, -0 +100%, 500V	1005-0007	04222	BPD.005	2	1		
C205	Capacitor: fixed, ceramic, .02uf, -0 +100%, 600V	1005-0004	71590	DD-203	1	1		
C206	Capacitor: fixed, mica, 390uuf, 5%, 500V	1003-0050	00853	RR-1339	1	1		
C207	Capacitor: fixed, mylar, .1uf, 20%, 150V	1008-0006	72928	338Y104M	1	1		
C301	Same as C202							
CR1	Diode, silicon	1281-0014	81483	SD-94	1	1		
CR2-4	Diode, silicon	1281-0013	81483	SD-91	5	5		

* Manufacturers' codes on last page. † Recommended 1-year isolated-use spares per MIL-E-17362A.

REFERENCE DESIGNATOR	DESCRIPTION	DYMEC STOCK NO.	*MFR. CODE	MFR. PART NO.	QTY.	†1-YR. SPA.
CR101-104	Stack, Rectifier, germanium	1297-0011	24446	4JA211FB 1AC1	1	1
CR105-109	Same as CR2					
CR201-207, 301-308	Diode, silicon: 1N847	1281-0031	73293		15	15
DS101	Lamp, incandescent, 6V	2870-0012	71744	Type 345	1	1
	Lampholder for above	2900-0013	72619	137-8536-9	1	1
	Lens for above	2925-0004	72619	137-931	1	1
F101	Fuse, 1 amp, Slo Blo	1955-0002	71400	MDL-1	1	10
F102	Fuse, 1.6 amp, Slo Blo	1955-0012	71400	MDL-1.6	1	10
	Fuseholders for above	1965-0001	75915	342012	2	1
J1-25	Receptacle, 3-pin, male: XLR-3-32-A95	2535-0056	71468		29	6
J101, 103	Receptacle, 37-pin, male: MS3102A28-21P	2538-0003	71468		2	1
J104	Receptacle, 37-pin, female: MS3102A28-21S	2537-0003	71468		1	1
J109	Receptacle, female, BNC	2536-0003	91737	1094/U	1	1
J110, 111, 113, 114	Same as J1					

* Manufacturers' codes on last page. † Recommended 1-year isolated-use spares per MIL-E-17362A.

REFERENCE DESIGNATOR	DESCRIPTION	DYMEC STOCK NO.	*MFR. CODE	MFR. PART NO.	QTY.	†1-YR. SPA.		
K1	Switch, stepping, type 45, 24V NOTE: Replace 48V coil with a 24V coil	1311-0037	04777	PW-12250-1		1		
K2, 201, 202	Relay, 500 ohm coil, 2 form C	1311-0039	04777	EQA type PE-402-B17	3	1		
K301-304	Relay, 4 form C, 24V	1311-0040	77342	KHP-17D11	1	1		
P1-25	Connector, 3-pin, female: XLR-3-11C-A95 (Mating connector for J1-25)	2535-0057	71468		28	6		
P101	Connector, 37-pin, female: MS3106B28-21S (Mating Connector for J101)	2539-0003	71468		1	1		
P103	Connector, 37-pin, female: pins A and B jumpered, and pins C and D jumpered: MS3106B28-21S (Mating connector for J103)	A2901-3046	04404		1	1		
P104	Connector, 37-pin, male: MS3106B28-21P (Mating connector for J104)	2540-0002	71468		1	1		
P111, 113, 114	Same as P1							
Q201	Transistor, germanium: 2N404	1271-0014	72699		1	1		
Q202-206	Transistor, germanium: 2N404A	1271-0023	72699		5	2		

* Manufacturers' codes on last page. † Recommended 1-year isolated-use spares per MIL-E-17362A.

REFERENCE DESIGNATOR	DESCRIPTION	DYMEC STOCK NO.	* MFR. CODE	MFR. PART NO.	QTY.	† 1-YR. SPA.		
R1-25	Resistor: fixed, composition, 47 ohm, 5%, 1/2W	1067-4705	01121	EB4705	25	6		
R26	Resistor: fixed, wirewound, 30 ohm, 5%, 8W	1160-0007	94310		1	1		
R27	Resistor: fixed, composition, 470 ohm, 5%, 2W	1068-4715	01121	HB4715	2	1		
R28	Resistor: fixed, composition, 4.7K, 5%, 1/2W	1067-4725	01121	EB4725	3	1		
R29	Resistor: fixed, composition, 5.6 ohm, 5%, 1W	1068-5605	01121	GB5605	1	1		
R30	Resistor: fixed, composition, 5.1K, 5%, 1/2W	1067-5125	01121	EB5125	1	1		
R101	Resistor: fixed, wirewound, 390 ohm, 1%, 5W	1160-0011	91637	Type RS-5	1	1		
R102	Resistor: fixed, composition, 15K, 5%, 1/2W	1067-1535	01121	EB1535	1	1		
R103	Resistor: fixed, composition, 56 ohm, 5%, 1/2W	1067-5605	01121	EB5605	1	1		
R201, 202	Resistor: fixed, composition, 510 ohm, 5%, 1/2W	1067-5115	01121	EB5115	1	1		
R203	Resistor: fixed, composition, 39K, 5%, 1/2W	1067-3935	01121	EB3935	1	1		
R204	Resistor: fixed, composition, 27K, 5%, 1/2W	1067-2735	01121	EB2735	2	1		
R205	Resistor: fixed, composition, 15K, 5%, 1/2W	1067-1535	01121	EB1535	2	1		
R206	Resistor: fixed, composition, 3.3K, 5%, 1/2W	1067-3325	01121	EB3325	1	1		
R208	Same as R27							

* Manufacturers' codes on last page. † Recommended 1-year isolated-use spares per MIL-E-17362A.

REFERENCE DESIGNATOR	DESCRIPTION	DYMEC STOCK NO.	*MFR. CODE	MFR. PART NO.	QTY.	†1-YR. SPA.		
R209	Resistor: fixed, composition, 120K, 5%, 1/2W	1067-1245	01121	EB1245	1	1		
R210	Resistor: fixed, composition, 270 ohm, 5%, 1/2W	1067-2715	01121	EB2715	2	1		
R211	Resistor: fixed, composition, 8.2K, 5%, 1/2W	1067-8225	01121	EB8225	1	1		
R212	Resistor: fixed, composition, 2.2K, 5%, 1/2W	1067-2225	01121	EB2225	1	1		
R213	Resistor: fixed, composition, 1K, 5%, 1/2W	1067-1025	01121	EB1025	1	1		
R214	Resistor: fixed, composition, 12K, 5%, 1/2W	1067-1235	01121	EB1235	1	1		
R215-217	Resistor: fixed, composition, 10K, 5%, 1/2W	1067-1035	01121	EB1035	4	1		
R218	Resistor: fixed, composition, 5.6K, 5%, 1/2W	1067-3625	01121	EB5625	1	1		
R219	Resistor: fixed, composition, 6.8K, 5%, 1/2W	1067-6825	01121	EB6825	1	1		
R220	Resistor: fixed, composition, 150K, 5%, 1/2W	1067-1545	01121	EB1545	1	1		
R221	Same as R210							
R222	Resistor: fixed, composition, 18K, 5%, 1/2W	1067-1835	01121	EB1835	1	1		
R223	Resistor: fixed, composition, 22K, 5%, 1/2W	1067-2235	01121	EB2235	1	1		
R224	Same as R204							
R225	Resistor: fixed, composition, 56K, 5%, 1/2W	1067-5635	01121	EB5635	1	1		

* Manufacturers' codes on last page. † Recommended 1-year isolated-use spares per MIL-E-17362A.

REFERENCE DESIGNATOR	DESCRIPTION	DYMEC STOCK NO.	*MFR. CODE	MFR. PART NO.	QTY.	†1-YR. SPA.		
R226	Resistor: fixed, composition, 820K, 5%, 1/2W	1067-8245	01121	EB8245	1	1		
R227, 229	Same as R28							
R228	Resistor: fixed, composition, 27 ohm, 5%, 1/2W	1067-2705	01121	EB2705	2	1		
R230	Same as R209							
R231	Resistor: fixed, composition, 100K, 5%, 1/2W	1067-1045	01121	EB1045	1	1		
R232	Same as R205							
R233	Same as R215							
R301	Same as R228							
RV1, 2	Varistor, 24V	1254-0003	04777	RY-56	2	1		
S1-25	Switch, multi, illuminated push button	1852-0009	82389	75-1106	5	2		
	Lamps for above	None	71744	1775	25	6		
S201	Switch, push button, DPDT	1852-0002	82389	1006	2	1		
S202	Switch, rotary	1851-0037	71590	CRL PA023	1	1		
S203	Same as S201							
T101	Transformer, power	1575-0040	Tranex Co.	4-0072	1	1		
W101	Cable, power	3170-0001	70903	KH-3088	1	1		

* Manufacturers' codes on last page. † Recommended 1-year isolated-use spares per MIL-E-17362A.

REFERENCE DESIGNATOR	DESCRIPTION	DYMEC STOCK NO.	*MFR. CODE	MFR. PART NO.	QTY.	†1-YR. SPA.		
A2, 3	Connector, printed circuit, 24-pin, (Key-21)	2535-0060	95354	SD624S-P21	2	1		
CR1	Diode, silicon	1281-0014	81483	SD-94	1	1		
CR2-5	Diode, silicon	1281-0013	81483	SD-91	4	4		
DS201	Lamp, incandescent	2870-0012	71744	Type 345	1	1		
	Lampholder for above	2900-0013	72619	137-8536-9	1	1		
	Lens for above	2925-0004	72619	137-931	1	1		
J26-50, 210, 211	Receptacle, 3-pin, male: XLR-3-32-A95 (DY-2903: J51-75, 310, 311) (DY-2904: J76-100, 410, 411)	2535-0056	71468		27	6		
J201, 203	Receptacle, 37-pin, male: MS3102A28-21P	2538-0003	71468		2	1		
	Mating connector for above: MS3106B28-21S	2539-0003	71468					
J202, 204	Receptacle, 37-pin, female: MS3102A28-21S (DY-2903: J302, 304) (DY-2904: J402, 404)	2537-0003	71468		2	1		
	Mating connector for above: MS3106B28-21P	2540-0002	71468					
K1	Switch, stepping, type 45, 24V	1311-0037	04777	PW-12250-1	1	1		
K2	Relay, 500 ohm coil, 2 form C	1311-0039	04777	EQA type PE-402-B17	1	1		

REFERENCE DESIGNATOR	DESCRIPTION	DYMEC STOCK NO.	*MFR. CODE	MFR. PART NO.	QTY.	†1-YR. SPA.		
P26-50	Connector, 3-pin, female: XLR-3-11C-A95 (DY-2903: P51-75) (DY-2904: P76-100)	2535-0057	71468		27	6		
R1-25	Resistor: fixed, composition, 47 ohm, 5%, 1/2W	1067-4705	01121	EB5704	25	6		
R26	Resistor: fixed, wirewound, 30 ohm, 5%, 8W	1160-0007	94310		1	1		
R27	Resistor: fixed, composition, 470 ohm, 5%, 2W	1069-4715	01121	EB4715	1	1		
R28	Resistor: fixed, composition, 4.7K, 5%, 1/2W	1067-4725	01121	EB4725	1	1		
R29	Resistor: fixed, composition, 5.6 ohm, 5%, 1W	1068-5.605	01121	GB5.605	1	1		
RV1, 2	Varistor, 24V	1254-0003	04777	RY-56	2	1		
S26-50	Switch, multi, illuminated push button (DY-2903: S51-75) (DY-2904: S76-100)	1852-0009	82389	7S-1106	5	2		
	Lamps for above	None	71744	1775	25	6		

* Manufacturers' codes on last page. † Recommended 1-year isolated-use spares per MIL-E-17362A.

TABLE 6-3.

CODE LIST OF MANUFACTURERS

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements. The date of revision and the date of the supplements used appear at the bottom of each page. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 handbooks.

Code No.	Manufacturer	Address
00000	U.S.A. Common	Any supplier of U.S.
00136	McCoy Electronics	Mount Holly Springs, Pa.
00213	Sage Electronics Corp.	Rochester, N.Y.
00334	Humidial	Colton, Calif.
00373	Garlock Inc., Electronics Products Div.	Camden, N.J.
00556	Aerovox Corp.	New Bedford, Mass.
00779	Amp, Inc.	Harrisburg, Pa.
00781	Aircraft Radio Corp.	Boonton, N.J.
00815	Northern Engineering Labortories, Inc.	Burlington, Wis.
00853	Sangamo Electric Co., Pickens Div.	Pickens, S.C.
00866	Goe Engineering Co.	Los Angeles, Calif.
00891	Carl E. Holmes Corp.	Los Angeles, Calif.
01121	Allen Bradley Co.	Milwaukee, Wis.
01255	Litton Industries, Inc.	Beverly Hills, Calif.
01281	TRW Semiconductors, Inc.	Lawndale, Calif.
01295	Texas Instruments, Inc. Transistor Products Div.	Dallas, Texas
01349	The Alliance Mfg. Co.	Alliance, Ohio
01589	Pacific Relays, Inc.	Van Nuys, Calif.
01930	Amerock Corp.	Rockford, Ill.
01961	Pulse Engineering Co.	Santa Clara, Calif.
02114	Ferroxcube Corp. of America	Saugerties, N.Y.
02286	Cole Rubber and Plastics Inc.	Palo Alto, Calif.
02660	Amphenol-Borg Electronics Corp.	Chicago, Ill.
02735	Radio Corp. of America, Semiconductor and Materials Div.	Somerville, N.J.
02771	Vocaline Co. of America, Inc.	Old Saybrook, Conn.
02777	Hopkins Engineering Co.	San Fernando, Calif.
03508	G.E. Semiconductor Prod. Dept.	Syracuse, N.Y.
03705	Apex Machine & Tool Co.	Dayton, Ohio
03797	Eldema Corp.	Compton, Calif.
03877	Transitron Electric Corp.	Wakefield, Mass.
03888	Pyrofilm Resistor Co.,Inc.	Cedar Knolls, N.J.
03954	Singer Co., Diehl Div., Finderne Plant	Somerville, N.J.
04009	Arrow, Hart and Hegeman Elect. Co.	Hartford, Conn.
04013	Taurus Corp.	Lambertville, N.J.
04062	Elmenco Products Co.	New York, N.Y.
04222	Hi-Q Division of Aerovox	Myrtle Beach, S.C.
04354	Precision Paper Tube Co.	Chicago, Ill.
04404	Dymec Division of Hewlett-Packard Co.	Palo Alto, Calif.
04651	Sylvania Electric Products, Microwave Device Div.	Mountain View, Calif.
04713	Motorola, Inc., Semiconductor Prod. Div.	Phoenix, Arizona
04732	Filtron Co., Inc., Western Div.	Culver City, Calif.
04773	Automatic Electric Co.	Northlake, Ill.
04796	Sequoia Wire Co.	Redwood City, Calif.
04811	Precision Coil Spring Co.	El Monte, Calif.
04870	P.M. Motor Company	Westchester, Ill.
05006	Twentieth Century Plastics, Inc.	Los Angeles, Calif.
05277	Westinghouse Electric Corp. Semi-Conductor Dept.	Youngwood, Pa.
05347	Ultronix, Inc.	San Mateo, Calif.
05593	Microtronic Engineering Co.	Sunnyvale, Calif.
05616	Cosmo Plastic (c o Electrical Spec. Co.)	Cleveland, Ohio
05624	Barber Colman Co.	Rockford, Ill.
05728	Tiffen Optical Co.	Roslyn Heights, Long Island, N.Y.
05729	Metro-Tel Corp.	Plainview, N.Y.
05783	Stewart Engineering Co.	Santa Cruz, Calif.
05820	Wakefield Engineering Inc.	Wakefield, Mass.
06004	The Bassick Co.	Bridgeport, Conn.
06175	Bausch and Lomb Optical Co.	Rochester, N.Y.
06402	E.T.A. Products Co. of America	Chicago, Ill.
06475	Western Devices Inc.	Burbank, Calif.
06540	Amatom Electronic Hardware Co., Inc.	New Rochelle, N.Y.
06555	Beede Electrical Instrument Co., Inc.	Penacook, N.H.
06666	General Devices Co., Inc.	Indianapolis, Ind.
06751	Nuclear Corp. of America U.S. Semcor Div.	Phoenix, Ariz.
06812	Torrington Mfg. Co., West Div.	Van Nuys, Calif.
06980	Eitel-McCullough Inc.	San Carlos, Calif.
07088	Kelvin Electric Co.	Van Nuys, Calif.
07115	Corning Glass Works Electronic Components Dept.	Bradford, Pa.
07126	Digitran Co.	Pasadena, Calif.
07137	Transistor Electronics Corp.	Minneapolis, Minn.
07138	Westinghouse Electric Corp. Electronic Tube Div.	Elmira, N.Y.
07149	Filmohm Corp.	New York, N.Y.
07233	Cinch-Graphik Co.	City of Industry, Calif.
07261	Avnet Corp.	Los Angeles, Calif.
07263	Fairchild Camera & Inst. Corp., Semiconductor Div.	Mountain View, Calif.
07322	Minnesota Rubber Co.	Minneapolis, Minn.
07387	The Birtcher Corp.	Los Angeles, Calif.
07700	Technical Wire Products Inc.	Cranford, N.J.
07910	Continental Device Corp.	Hawthorne, Calif.
07933	Raytheon Mfg. Co., Semiconductor Div.	Mountain View, Calif.
07966	Shockley Semi-Conductor Laboratories	Palo Alto, Calif.
07980	Boonton Radio Corp.	Rockaway, N.J.
08145	U.S. Engineering Co.	Los Angeles, Calif.
08289	Blinn, Delbert, Co.	Pomona, Calif.
08358	Burgess Battery Co.	Niagara Falls,Ontario, Canada
08664	The Bristol Co.	Waterbury, Conn.
08717	Sloan Company	Sun Valley,Calif.
08718	ITT Cannon Electric Inc., Phoenix Div.	Phoenix, Arizona
08792	CBS Electronics Semiconductor Operations, Div. of C.B.S.,Inc.	Lowell, Mass.
08984	Mel-Rain	Indianapolis, Ind.
09026	Babcock Relays Div.	Costa Mesa, Calif.
09134	Texas Capacitor Co.	Houston, Texas
09145	Atohm Electronics	Sun Valley, Calif.
09250	Electro Assemblies, Inc.	Chicago, Ill.
09569	Mallory Battery Co. of Canada, Ltd.	Toronto, Ontario, Canada
10214	General Transistor Western Corp.	Los Angeles, Calif.
10411	Ti-Tal, Inc.	Berkeley,Calif.
10646	Carborundum Co.	Niagara Falls, N.Y.
11236	CTS of Berne,Inc.	Berne,Ind.
11237	Chicago Telephone of California, Inc.	So. Pasadena, Calif.
11242	Bay State Electronics Corp.	Waltham, Mass.
11312	Microwave Electronics Corp.	Palo Alto, Calif.
11534	Duncan Electronics Inc.	Costa Mesa, Calif.
11711	General Instrument Corp., Semiconductor Div., Products Group	Newark, N.J.
11717	Imperial Electronic, Inc.	Buena Park, Calif.
11870	Melabs, Inc.	Palo Alto, Calif.
12136	Philadelphia Handle Co.	Camden, N.J.
12697	Clarostat Mfg. Co.	Dover, N.H.
12859	Nippon Electric Co., Ltd.	Tokyo, Japan
12881	Metex Electronics Corp.	Clark, N.J.
12930	Delta Semiconductor Inc.	Newport Beach, Calif.
13103	Thermolloy	Dallas, Texas
13396	Telefunken (G.M.B.H.)	Hanover, Germany
13835	Midland-Wright Div. of Pacific Industries, Inc.	Kansas City, Kansas
14099	Sem-Tech	Newbury Park, Calif.
14193	Calif. Resistor Corp.	Santa Monica, Calif.
14298	American Components,Inc.	Conshohocken, Pa.
14493	Hewlett-Packard Company	Loveland,Colo.
14655	Cornell Dubilier Electric Corp.	Newark, N.J.
14960	Williams Mfg. Co.	San Jose, Calif.
15203	Webster Electronics Co.	New York, N.Y.
15291	Adjustable Bushing Co.	N.Hollywood, Calif.
15558	Micron Electronics	Garden City, Long Island, N.Y.
15772	Twentieth Century Coil Spring Co.	Santa Clara, Calif.
15818	Amelco Inc.	Mt. View, Calif.
15909	Daven Div. Thomas A. Edison Ind. McGraw-Edison Co.	Long Island City, N.Y.
16037	Spruce Pine Mica Co.	Spruce Pine, N.C.
16352	Computer Diode Corp.	Lodi, N.J.
16688	Ideal Prec. Meter Co., Inc. De Jur Meter Div.	Brooklyn, N.Y.
16758	Delco Radio Div. of G.M. Corp.	Kokomo, Ind.
17109	Thermonetics Inc.	Canoga Park, Calif.
17474	Tranex Company	Mountain View, Calif.
18476	Ty-Car Mfg. Co.,Inc.	Holliston, Mass.
18486	Radio Industries	Des Plaines, Ill.
18583	Curtis Instrument, Inc.	Mt. Kisco, N.Y.
18873	E.I. DuPont and Co.,Inc.	Wilmington, Del.
19315	The Bendix Corp., Eclipse-Pioneer Div.	Teterboro, N.J.
19500	Thomas A. Edison Industries, Div. of McGraw-Edison Co.	West Orange, N.J.
19701	Electra Mfg. Co.	Independence, Kansas
20183	General Atronics Corp.	Philadelphia, Pa.
21226	Executone, Inc.	New York, N.Y.
21520	Fansteel Metallurgical Corp.	No. Chicago, Ill.
21335	The Fafnir Bearing Co.	New Britain, Conn.
24455	G.E. Lamp Division	Nela Park, Cleveland, Ohio
24655	General Radio Co.	West Concord, Mass.
26365	Gries Reproducer Corp.	New Rochelle, N.Y.
26462	Grobet File Co. of America, Inc.	Carlstadt, N.J.
26992	Hamilton Watch Co.	Lancaster, Pa.
28480	Hewlett-Packard Co.	Palo Alto, Calif.
33173	G.E. Receiving Tube Dept.	Owensboro, Ky.
35434	Lectrohm Inc.	Chicago, Ill.
36196	Stanwyck Coil Products Ltd.	Hawkesbury, Ontario, Canada
37942	P.R. Mallory & Co.,Inc.	Indianapolis, Ind.
39543	Mechanical Industries Prod. Co.	Akron, Ohio
40920	Miniature Precision Bearings, Inc.	Keene, N.H.
42190	Muter Co.	Chicago, Ill.
43990	C.A. Norgren Co.	Englewood, Colo.
44655	Ohmite Mfg. Co.	Skokie, Ill.
47904	Polaroid Corp.	Cambridge, Mass.
48620	Precision Thermometer & Inst. Co.	Southampton, Pa.
49956	Raytheon Company	Lexington, Mass.
52090	Rowan Controller Co.	Westminster, Md.
52983	Sanborn Co.	Waltham, Mass.
54294	Shallcross Mfg. Co.	Selma, N.C.
55026	Simpson Electric Co.	Chicago, Ill.
55933	Sonotone Corp.	Elmsford, N.Y.
55938	Raytheon Co. Commercial Apparatus & Systems Div.	So. Norwalk, Conn.
56137	Spaulding Fibre Co.,Inc.	Tonawanda, N.Y.
56289	Sprague Electric Co.	North Adams, Mass.
59446	Telex, Inc.	St.Paul, Minn.
59730	Thomas & Betts Co.	Elizabeth, N.J.
60741	Triplett Electrical Inst. Co.	Bluffton, Ohio
61775	Union Switch and Signal, Div. of Westinghouse Air Brake Co.	Pittsburgh, Pa.
62119	Universal Electric Co.	Owosso, Mich.
63743	Ward-Leonard Electric Co.	Mt. Vernon, N Y
64959	Western Electric Co.,Inc.	New York, N.Y.
65092	Weston Inst. Div. of Daystrom, Inc.	Newark, N.J.
66295	Wittek Mfg. Co.	Chicago, Ill.
66346	Revere Wollansak Div. Minn. Mining & Mfg. Co.	St. Paul, Minn.
70276	Allen Mfg. Co.	Hartford, Conn.
70309	Allen Mfg. Co.	Hartford, Conn.
70318	Allmetal Screw Product Co. Inc.	Garden City, N.Y.
70485	Atlantic India Rubber Works, Inc.	Chicago, Ill.
70563	Amperite Co.,Inc.	Union City, N. J.
70903	Belden Mfg. Co.	Chicago, Ill.
70998	Bird Electronic Corp.	Cleveland, Ohio
71002	Birnbach Radio Co.	New York, N.Y.
71041	Boston Gear Works Div. of Murray Co. of Texas	Quincy, Mass.
71218	Bud Radio, Inc.	Willoughby, Ohio
71286	Camloc Fastener Corp.	Paramus, N.J.
71313	Cardwell Condenser Corp.	Lindenhurst L.I., N.Y.
71400	Bussmann Mfg. Div. of McGraw-Edison Co.	St. Louis, Mo.
71436	Chicago Condenser Corp.	Chicago, Ill.
71447	Calif. Spring Co.,Inc.	Pico-Rivera, Calif.
71450	CTS Corp.	Elkhart, Ind.
71468	ITT Cannon Electric Inc.	Los Angeles, Calif.
71471	Cinema Engineering Co.	Burbank, Calif.
71482	C.P. Clare & Co.	Chicago, Ill.
71590	Centralab Div. of Globe Union Inc.	Milwaukee, Wis.
71616	Commercial Plastics Co.	Chicago, Ill.
71700	The Cornish Wire Co.	New York, N. Y.
71744	Chicago Miniature Lamp Works	Chicago, Ill.
71753	A.O. Smith Corp., Crowley Div.	West Orange, N.J.
71785	Cinch Mfg. Co., Howard B. Jones Div.	Chicago, Ill.
71984	Dow Corning Corp.	Midland, Mich.
72136	Electro Motive Mfg. Co.,Inc.	Willimantic, Conn.
71707	Coto Coil Co.,Inc.	Providence, R.I.
72354	John E. Fast Co., Div. Victoreen Instr. Co.	Chicago, Ill.
72619	Dialight Corp.	Brooklyn, N.Y.
72656	Indiana General Corp., Electronics Div.	Keasby, N.J.
72765	Drake Mfg. Co.	Chicago, Ill.
72825	Hugh H. Eby Inc.	Philadelphia, Pa.
72928	Gudeman Co.	Chicago, Ill.
72954	Robert M. Hadley Co.	Los Angeles, Calif.
72982	Erie Technological Products, Inc.	Erie, Pa.
73061	Hansen Mfg. Co., Inc.	Princeton, Ind.
73076	H.M. Harper Co.	Chicago, Ill.
73138	Helipot Div. of Beckman Inst., Inc.	Fullerton, Calif.
73293	Hughes Products Division of Hughes Aircraft Co.	Newport Beach, Calif.
73445	Amperex Electronic Co., Div. of North American Phillips Co., Inc.	Hicksville, N. Y.
73506	Bradley Semiconductor Corp.	Hamden, Conn.
73559	Carling Electric, Inc.	Hartford, Conn.
73682	George K. Garrett Co., Div. MSL Industries Inc.	Philadelphia, Pa.
73734	Federal Screw Products Inc.	Chicago, Ill.
73743	Fischer Special Mfg. Co.	Cincinnati, Ohio
73793	The General Industries Co.	Elyria, Ohio
73846	Goshen Stamping & Tool Co.	Goshen, Ind.
73899	JFD Electronics Corp.	Brooklyn, N.Y.
73905	Jennings Radio Mfg. Corp.	San Jose, Calif.
74276	Signalite Inc.	Neptune, N.J.
74455	J.H. Winns, and Sons	Winchester, Mass.
74861	Industrial Condenser Corp.	Chicago, Ill.
74868	R.F. Products Division of Amphenol-Borg Electronics Corp.	Danbury, Conn.
74970	E.F. Johnson Co.	Waseca, Minn.
75042	International Resistance Co.	Philadelphia, Pa.
75378	James Knights Co.	Sandwich, Ill.
75382	Kulka Electric Corporation	Mt. Vernon, N.Y.
75818	Lenz Electric Mfg. Co.	Chicago, Ill.
75915	Littlefuse, Inc.	Des Plaines, Ill.
76005	Lord Mfg. Co.	Erie, Pa.
76210	C.W. Marwedel	San Francisco, Calif.
76433	General Instrument Corp., Micamold Div.	Newark, N.J.
76487	James Millen Mfg. Co.,Inc.	Malden, Mass.
76493	J.W. Miller Co.	Los Angeles, Calif.
76530	Monadnock Mills	San Leandro, Calif.
76545	Mueller Electric Co.	Cleveland, Ohio
76854	Oak Manufacturing Co.	Crystal Lake, Ill.
77068	The Bendix Corp. Bendix Pacific Div.	No. Hollywood, Calif.
77075	Pacific Metals Co.	San Francisco, Calif.
77221	Phanostran Instrument and Electronic Co.	South Pasadena, Calif.
77252	Philadelphia Steel and Wire Corp.	Philadelphia, Pa.
77342	American Machine & Foundry Co. Potter & Brumfield Div.	Princeton, Ind.
77630	TRW Electronic Components Div.	Camden, N.J.
77638	General Instrument Corp., Rectifier Div.	Brooklyn, N.Y.
77764	Resistance Products Co.	Harrisburg, Pa.
77969	Rubbercraft Corp. of Calif.	Torrance, Calif.
78189	Shakeproof Division of Illinois Tool Works	Elgin, Ill.
78283	Signal Indicator Corp.	New York, N.Y.
78290	Struthers-Dunn Inc.	Pitman, N.J.
78452	Thompson-Bremer & Co.	Chicago, Ill.
78471	Tilley Mfg. Co.	San Francisco, Calif.
78488	Stackpole Carbon Co.	St. Marys, Pa.
78493	Standard Thomson Corp.	Waltham, Mass.
78553	Tinnerman Products, Inc.	Cleveland, Ohio
78790	Transformer Engineers	San Gabriel, Calif.
78947	Ucinite Co.	Newtonville, Mass.
79136	Waldes Kohinoor Inc.	Long Island City, N.Y.
79142	Veeder Root, Inc.	Hartford, Conn.
79251	Wenco Mfg. Co.	Chicago, Ill.
79727	Continental-Wirt Electronics Corp.	Philadelphia, Pa.
79963	Zierick Mfg. Corp.	New Rochelle, N.Y.
80031	Mepco Division of Sessions Clock Co.	Morristown, N.J.
80120	Schnitzer Alloy Products Co.	Elizabeth, N.J.
80130	Times Telephoto Equipment	New York, N.Y.
80131	Electronic Industries Association. Any brand Tube meeting EIA standards-	Washington, D.C.
80207	Unimax Switch, Div. Maxon Electronics Corp.	Wallingford, Conn.
80223	United Transformer Corp.	New York, N.Y.
80248	Oxford Electric Corp.	Chicago, Ill.
80294	Bourns Laboratories, Inc.	Riverside, Calif.
80411	Robertshaw Controls Co.	Hillsboro, Ohio
80486	All Star Products Inc.	Defiance, Ohio
80509	Avery Adhesive Label Corp.	Monrovia, Calif.

From: FSC. Handbook Supplements
H4-1 Dated DECEMBER 1964
H4-2 Dated MARCH 1962

TABLE 6-3.

CODE LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer	Address
80583	Hammarlund Co., Inc.	New York, N.Y.
80540	Stevens, Arnold, Co., Inc.	Boston, Mass.
81030	International Instruments Inc.	Orange, Conn.
81073	Grayhill Co.	LaGrange, Ill.
81095	Triad Transformer Corp.	Venice, Calif.
81312	Winchester Electronics Co., Inc.	Norwalk, Calif.
81349	Military Specification	....
81415	Wilkor Products, Inc.	Cleveland, Ohio
81483	International Rectifier Corp.	El Segundo, Calif.
81541	The Airpax Products Co.	Cambridge, Mass.
81860	Barry Controls, Div. Barry Wright Corp.	Waterton, Mass.
82042	Carter Precision Electric Co.	Skokie, Ill.
82047	Sperti Faraday Inc., Cooper Hewitt Electric Div.	Hoboken, N.J.
82142	Jeffers Electronics Division of Speer Carbon Co.	Du Bois, Pa.
82170	Fairchild Camera & Inst. Corp., Defense Prod. Division	Clifton, N.J.
82209	Maguire Industries, Inc.	Greenwich, Conn.
82219	Sylvania Electric Prod. Inc. Electronic Tube Division	Emporium, Pa.
82376	Astron Division, Renwell Industries Inc.	East Newark, N.J.
82389	Switchcraft, Inc.	Chicago, Ill.
82647	Metals & Controls Inc. Spencer Products	Attleboro, Mass.
82768	Phillips-Advance Control Co.	Joliet, Ill.
82866	Research Products Corp.	Madison, Wis.
82877	Rotron Mfg. Co., Inc.	Woodstock, N.Y.
82893	Vector Electronic Co.	Glendale, Calif.
83053	Western Washer Mfg. Co.	Los Angeles, Calif.
83058	Carr Fastener Co.	Cambridge, Mass.
83086	New Hampshire Ball Bearing, Inc.	Peterborough, N.H.
83125	General Instrument Corp., Capacitor Div.	Darlington, S.C.
83148	ITT Wire and Cable Div.	Los Angeles, Calif.
83186	Victory Engineering Corp.	Springfield, N.J.
83298	Bendix Corp., Red Bank Div.	Red Bank, N.J.
83315	Hubbell Corp.	Mundelein, Ill.
83330	Smith, Herman H., Inc.	Brooklyn, N.Y.
83385	Central Screw Co.	Chicago, Ill.
83501	Gavitt Wire and Cable Co. Div. of Amerace Corp.	Brookfield, Mass.
83594	Burroughs Corp. Electronic Tube Div.	Plainfield, N.J.
83740	Eveready Div. National Carbon Div. Union Carbide Corp.	New York, N.Y.
83777	Model Eng. and Mfg., Inc.	Huntington, Ind.
83821	Loyd Scruggs Co.	Festus, Mo.
84171	Arco Electronics Inc.	Great Neck, N.Y.
84396	A.J. Glesener Co., Inc.	San Francisco, Calif.
84411	TRW Capacitor Div.	Ogallala, Neb.
84970	Sarkes Tarzian, Inc.	Bloomington, Ind.
85454	Boonton Molding Company	Boonton, N.J.
85471	A.B. Boyd Co.	San Francisco, Calif.
85474	R.M. Bracamonte & Co.	San Francisco, Calif.
85660	Koiled Kords, Inc.	Hamden, Conn.
85911	Seamless Rubber Co.	Chicago, Ill.
86197	Clifton Precision Products Co., Inc.	Clifton Heights, Pa.
86579	Precision Rubber Products Corp.	Dayton, Ohio
86684	Radio Corp. of America, Electronic Comp. & Devices Div.	Harrison, N.J.
87216	Philco Corporation (Lansdale Division)	Lansdale, Pa.
87473	Western Fibrous Glass Products Co.	San Francisco, Calif.
87664	Van Waters & Rogers Inc.	San Francisco, Calif.
87930	Tower Mfg. Corp.	Providence, R.I.
88140	Cutler-Hammer, Inc.	Lincoln, Ill.
88220	Gould-National Batteries, Inc.	St. Paul, Minn.
88421	Federal Telephone & Radio Corp.	Clifton, N.J.
88698	General Mills, Inc.	Buffalo, N.Y.
89231	Graybar Electric Co.	Oakland, Calif.
89473	General Electric Distributing Corp.	Schenectady, N.Y.
89665	United Transformer Co.	Chicago, Ill.
90179	US Rubber Co., Consumer Ind. & Plastics Prod. Div.	Passaic, N.J.
90970	Bearing Engineering Co.	San Francisco, Calif.
91260	Connor Spring Mfg. Co.	San Francisco, Calif.
91345	Miller Dial & Nameplate Co.	El Monte, Calif.
91418	Radio Materials Co.	Chicago, Ill.
91506	Augat Inc.	Attleboro, Mass.
91637	Dale Electronics, Inc.	Columbus, Nebr.
91662	Elco Corp.	Willow Grove, Pa.
91737	Gremar Mfg. Co., Inc.	Wakefield, Mass.
91827	K F Development Co.	Redwood City, Calif.
91929	Honeywell Inc., Micro Switch Div.	Freeport, Ill.
91961	Nahm-Bros. Spring Co.	Oakland, Calif.
92180	Tru-Connector Corp.	Peabody, Mass.
92367	Elgeet Optical Co., Inc.	Rochester, N.Y.
92196	Universal Industries, Inc.	City of Industry, Calif.
92607	Tensolite Insulated Wire Co., Inc.	Tarrytown, N.Y.
93332	Sylvania Electric Prod. Inc. Semiconductor Div.	Woburn, Mass.
93369	Robbins and Myers, Inc.	New York, N.Y.
93410	Stevens Mfg. Co., Inc.	Mansfield, Ohio
93788	Howard J. Smith Inc.	Port Monmouth, N.J.
93929	G.V. Controls	Livingston, N.J.
94137	General Cable Corp.	Bayonne, N.J.
94144	Raytheon Co., Comp. Div., Ind. Comp. Operations	Quincy, Mass.
94148	Scientific Electronics Products, Inc.	Loveland, Colo.
94154	Tung-Sol Electric, Inc.	Newark, N.J.
94197	Curtiss-Wright Corp. Electronics Div.	East Paterson, N.J.
94222	South Chester Corp.	Chester, Pa.
94310	Tru-Ohm Products Memcor Components Div.	Huntington, Ind.
94330	Wire Cloth Products, Inc.	Bellwood, Ill.
94682	Worcester Pressed Aluminum Corp.	Worcester, Mass.
95023	George A. Philbrick Researchers, Inc.	Boston, Mass.
95236	Allies Products Corp.	Miami, Fla.
95238	Continental Connector Corp.	Woodside, N.Y.
95263	Leecraft Mfg. Co., Inc.	Long Island, N.Y.
95264	Lerco Electronics, Inc.	Burbank, Calif.
95265	National Coil Co.	Sheridan, Wyo.
95275	Vitramon, Inc.	Bridgeport, Conn.
95348	Gordos Corp.	Bloomfield, N.J.
95354	Methode Mfg. Co.	Chicago, Ill.
95712	Dage Electric Co., Inc.	Franklin, Ind.
95987	Weckesser Co.	Chicago, Ill.
96067	Huggins Laboratories	Sunnyvale, Calif.
96095	Hi-Q Div. of Aerovox Corp.	Olean, N.Y.
96256	Thordarson-Meissner Div. of Maguire Industries, Inc.	Mt. Carmel, Ill.
96296	Solar Manufacturing Co.	Los Angeles, Calif.
96330	Carlton Screw Co.	Chicago, Ill.
96341	Microwave Associates, Inc.	Burlington, Mass.
96501	Excel Transformer Co.	Oakland, Calif.
97464	Industrial Retaining Ring Co.	Irvington, N.J.
97539	Automatic & Precision Mfg.	Englewood, N.J.
97979	Reon Resistor Corp.	Yonkers, N.Y.
97983	Litton System Inc., Adler-Westric Commun. Div.	New Rochelle, N.Y.
98141	R-Troncis, Inc.	Jamaica, N.Y.
98159	Rubber Teck, Inc.	Gardena, Calif.
98220	Francis L. Moseley	Pasadena, Calif.
98278	Microdot, Inc.	So. Pasadena, Calif.
98291	Sealectro Corp.	Mamaroneck, N.Y.
98405	Carad Corp.	Redwood City, Calif.
98731	General Mills Inc., Electronics Div.	Minneapolis, Minn
98821	North Hills Electronics, Inc.	Glen Cove, N.Y
98925	Semiconductor Div. of Clevite Corp.	Waltham, Mass
98978	International Electronic Research Corp.	Burbank, Cali
99109	Columbia Technical Corp.	New York, N.Y
99313	Varian Associates	Palo Alto, Cali
99515	Marshall Ind. Elect. Products Div.	San Marino, Cali
99707	Control Switch Division, Controls Co. of America	El Segundo, Cali
99800	Delevan Electronics Corp.	East Aurora, N.Y
99848	Wilco Corporation	Indianapolis, Ind
99934	Renbrandt, Inc.	Boston, Mass.
99942	Hoffman Electronics Corp. Semiconductor Div.	El Monte, Calif.
99957	Technology Instrument Corp. of Calif.	Newbury Park, Calif.

THE FOLLOWING H-P VENDORS HAVE NO NUMBER ASSIGNED IN THE LATEST SUPPLEMENT TO THE FEDERAL SUPPLY CODE FOR MANUFACTURERS HANDBOOK.

Code No.	Manufacturer	Address
0000F	Malco Tool and Die	Los Angeles, Calif.
0000M	Western Coil Div. of Automatic Ind., Inc.	Redwood City, Calif.
0000Z	Willow Leather Products Corp.	Newark, N.J.
000AA	British Radio Electronics Ltd.	Washington, D.C.
000AB	ETA	Englan
000AK	Siemens-America Components Div.	White Plains, N.Y.
000BB	Precision Instrument Components Co.	Van Nuys, Calif.
000MM	Rubber Eng. & Development	Hayward, Calif.
000NN	A "N" D Mfg. Co.	San Jose, Calif.
000QQ	Cooltron	Oakland, Calif.
000SS	Control of Elgin Watch Co.	Burbank, Calif.
000WW	California Eastern Lab.	Burlington, Calif.
000YY	S.K. Smith Co.	Los Angeles, Calif.

From: FSC. Handbook Supplements
H4-1 Dated DECEMBER 1964
H4-2 Dated MARCH 1962

SALES AND SERVICE OFFICES
UNITED STATES and CANADA

ALABAMA
Huntsville, 35802
2003 Byrd Spring Rd. S.W.
(205) 881-4591
TWX: 510-579-2204

ALASKA
Bellevue, Wash. 98004
11656 N.E. 8th Street
(206) 454-3971
TWX: 910-443-2303

ARIZONA
Scottsdale, 85251
3009 No. Scottsdale Rd.
(602) 945-7601
TWX: 602-949-0111

Tucson, 85716
232 So. Tucson Blvd.
(602) 623-2564
TWX: 602-792-2759

CALIFORNIA
North Hollywood, 91604
3939 Lankershim Blvd.
(213) 877-1282 and 766-3811
TWX: 910-499-2170

Sacramento, 95821
2591 Carlsbad Ave.
(916) 482-1463
TWX: 916-444-8683

San Diego, 92106
1055 Shafter Street
(714) 223-8103
TWX: 714-276-4263

Palo Alto, 94303
1101 Embarcadero Rd.
(415) 327-6500
TWX: 910-373-1280

COLORADO
Englewood, 80110
7965 East Prentice
(303) 771-3455
TWX: 910-935-0705

CONNECTICUT
Middletown, 06457
589 Saybrook Rd.
(203) 346-6611
TWX: 710-428-2036

FLORIDA
Miami, 33125
2907 Northwest 7th St.
(305) 635-6461

Orlando, 32803
621 Commonwealth Ave.
(305) 425-5541
TWX: 305-841-2568

St. Petersburg, 33708
410-150th Ave., Madeira Beach
(813) 391-0211 and 391-1829
TWX: 813-391-0666

GEORGIA
Atlanta, 30305
3110 Maple Drive, N.E.
(404) 233-1141
TWX: 810-751-3283

HAWAII
North Hollywood, Calif. 91604
3939 Lankershim Blvd.
(213) 877-1282
TWX: 910-499-2170

ILLINOIS
Skokie, 60076
5500 Howard Street
(312) 677-0400
TWX: 910-223-3613

INDIANA
Indianapolis, 46205
3919 Meadows Dr.
(317) 546-4891
TWX: 317-635-4300

LOUISIANA
New Orleans
(504) 522-4359

MARYLAND
Baltimore, 21207
6660 Security Blvd.
(301) 944-5400
TWX: 710-862-0850

Rockville, 20852
12303 Twinbrook Pkwy.
(301) 427-7560
TWX: 710-828-9684

MASSACHUSETTS
Burlington, 01803
Middlesex Turnpike
(617) 272-9000
TWX: 710-332-0382

MICHIGAN
Southfield, 48076
24315 Northwestern Hwy.
(313) 353-9100
TWX: 313-357-4425

MINNESOTA
St. Paul, 55114
2459 University Ave.
(612) 646-7881
TWX: 910-563-3734

MISSOURI
Kansas City, 64114
9208 Wyoming Place
(816) 333-2445
TWX: 910-771-2087

St. Louis, 63144
2812 South Brentwood Blvd.
(314) 644-0220
TWX: 910-760-1670

NEW JERSEY
Eatontown, 07724
(201) 747-1060

Englewood, 07631
391 Grand Avenue
(201) 567-3933
TWX: 510-230-9709

NEW MEXICO
Albuquerque, 87108
6501 Lomas Blvd., N.E.
(505) 255-5586
TWX: 910-989-1655

Las Cruces, 88001
114 S. Water Street
(505) 526-2486
TWX: 910-983-0550

NEW YORK
New York, 10021
236 East 75th Street
(212) 879-2023
TWX: 710-581-4376

Rochester, 14623
39 Saginaw Drive
(716) 473-9500
TWX: 510-253-5981

Poughkeepsie, 12601
82 Washington Street
(914) 454-7330
TWX: 914-452-7425

Syracuse, 13211
5858 East Molloy Rd.
(315) 454-2486
TWX: 710-541-0482

Endicott, 13764
1219 Campville Rd.
(607) 754-0050
TWX: 510-252-0890

NORTH CAROLINA
High Point, 27262
1923 N. Main Street
(919) 882-6873
TWX: 510-926-1516

OHIO
Cleveland, 44129
5579 Pearl Road
(216) 884-9209
TWX: 216-888-0715

Dayton, 45409
1250 W. Dorothy Lane
(513) 298-0351
TWX: 513-944-0090

OKLAHOMA
Oklahoma City
(405) 235-7062

PENNSYLVANIA
Camp Hill
(717) 737-6791

West Conshohocken, 19428
144 Elizabeth Street
(215) 248-1600 and 828-6200
TWX: 518-660-8715

Monroeville, 15146
Monroe Complex
Building 2
Suite 2
Moss Side Blvd.
(412) 271-5227
TWX: 710-797-3650

TEXAS
Dallas, 75209
P.O. Box 7166, 3605 Inwood Rd.
(214) 357-1881
TWX: 910-861-4081

Houston, 77027
P.O. Box 22813, 4242 Richmond Ave.
(713) 667-2407
TWX: 713-571-1353

UTAH
Salt Lake City, 84115
1482 Major St.
(801) 486-8166
TWX: 801-521-2604

VIRGINIA
Richmond, 23230
2112 Spencer Road
(703) 282-5451
TWX: 710-956-0157

WASHINGTON
Bellevue, 98004
11656 N.E. 8th St.
(206) 454-3971
TWX: 910-443-2303

GOVERNMENT CONTRACTING OFFICE
San Antonio, Texas 78226
Hewlett-Packard
Contract Marketing Division
225 Billy Mitchell Road
(512) 434-4171
TWX: 512-571-0955

CANADA
Montreal, Quebec
Hewlett-Packard (Canada) Ltd.
8270 Mayrand Street
(514) 735-2273
TWX: 610-421-3484
Telex: 01-2819

Ottawa, Ontario
Hewlett-Packard (Canada) Ltd.
1762 Carling Avenue
(613) 722-4223
TWX: 610-562-1952

Toronto, Ontario
Hewlett-Packard (Canada) Ltd.
1415 Lawrence Avenue West
(416) 249-9196
TWX: 610-492-2382

Vancouver, B.C.
Hewlett-Packard (Canada) Ltd.
2184 W. Broadway
(604) 738-7520
TWX: 610-922-5059

5/66

HEWLETT PACKARD
hp
DYMEC DIVISION
395 Page Mill Road, Palo Alto, California 94306

M0228

SALES AND SERVICE OFFICES
INTERNATIONAL - Electronic Equipment

ARGENTINA
Mauricio A. Suarez
Telecommunicaciones
Carlos Calvo 224
Buenos Aires
Tel. (30-6312) (34-9087)

AUSTRALIA
Sample Electronics (Vic) Pty., Ltd.
9-11 Cremorne Street
Richmond E.1, Victoria
Tel. 42-4757

Sample Electronics (N.S.W.) Pty, Ltd.
4 Grose Street
Glebe, New South Wales
Tel. 69-6338

AUSTRIA
Unilabor H.m.b.H.
Wissenschaftliche Instrumente
Rummelhardtgasse 6/3
P.O. Box 33, Vienna IX/71
Tel. 426 181

BELGIUM
Hewlett-Packard Benelux S.A.
20-24 rue de l'Hopital
Brussels
Tel. 11 22 20

BRAZIL
Ciental Importacao e Comercio Ltda.
Rua des Eliseu Guilherme, 62
Sao Paulo 8
Tel. 70-2318

CHILE
Hector Calcagni
Casilla 13942
Santiago
Tel. 6.42.26

DENMARK
Tage Olsen A/S
Ronnegade 1
Copenhagen 0
Tel. 29 48 00

FINLAND
INTO O Y
Meritullinkatu 11
P.O. Box 153
Helsinki
Tel. 6 11 33

FRANCE
Hewlett-Packard France
150 Boulevard Massena
Paris 13
Tel. 707 97 19

Hewlett-Packard France
2 rue Tete d'Or
Lyon, 6 - Rhone
Tel. 52 35 66

GERMANY
Hewlett-Packard Vertriebs-GmbH
Kurhessenstrasse 95
Frankfurt a. Main
Tel. 52 00 36

Hewlett-Packard Vertriebs-GmbH
Reginfriedstrasse 13, Munich 9
Tel. 49 51 21

Hewlett-Packard Vertriebs-GmbH
Beim Strohhause 26/28
Hamburg 1
Tel. 24 05 51

Hewlett-Packard Vertriebs-GmbH
(Technisches Buro)
Herrenberger Strasse 110
Böblingen, Wurttemberg
Tel. 6971

Hewlett-Packard Vertriebs-GmbH
Lietzenburger Strasse 30
1 Berlin W 30
Tel. 24 86 36

Hewlett-Packard Vertriebs-GmbH
Achenbachstrasse 15
4 Dusseldorf 1,
Tel. 68 52 58

GREECE
K. Karayannis
Klaftmonos Square
Athens 124
Tel. 230 301

INDIA
The Scientific Instrument Co., Ld.
6, Tej Bahadur Sapru Road
Allahabad 1
Tel. 2451

The Scientific Instrument Co., Ld.
240, Dr. Dadabhai Naoroji Road
Bombay 1
Tel. 26-2642

The Scientific Instrument Co., Ld.
11 Esplanade East, Calcutta 1
Tel. 23-4129

The Scientific Instrument Co., Ld.
30 Mount Road, Madras 1
Tel. 86339

The Scientific Instrument Co., Ld.
B-7, Ajmeri Gate Extn.
New Delhi 1
Tel. 271053

IRAN
Telecom, Ltd.
P.O. Box 1812
Teheran
Tel. 43850, 48111

ISRAEL
Electronics & Engineering Ltd.
Division of Motorola Israel Ltd.
16, Kremenetski Street, Tel-Aviv
Tel. 35021

ITALY
Hewlett-Packard Italiana S.p.A.
Viale Lunigiana 46, Milan
Tel. 69 15 84

Hewlett-Packard Italiana S.p.A.
Palazzo Italia
Piazza Marconi 25, Rome-Eur
Tel. 591 2544

JAPAN
Yokogawa-Hewlett-Packard Ltd.
59, 1-chome
Yoyogi
Shibuya-ku
Tokyo,
Tel. 370-2281

Yokogawa-Hewlett-Packard Ltd.
8, Umeda
Kita-ku, Osaka City
Tel. 313-0091

Yokogawa-Hewlett-Packard Ltd.
4, 3-chome
Himeikedori
Chigusa-ku, Nagoya City
Tel. 751-8545

KOREA
American Trading Co., Korea, Ltd.
Seoul P.O. Box 1103
112-35 Sokong-Dong
Jung-ku, Seoul
Tel. 3.7049, 3.7613

LEBANON
Constantin E. Macridis
Clemenceau Street
Clemenceau Center
Beirut
Tel. 220846

NETHERLANDS
Hewlett-Packard Benelux, N.V.
23 Burg, Roellstraat
Amsterdam, W.
Tel. (020) 13 28 98

NEW ZEALAND
Sample Electronics (N.Z.) Ltd.
8 Matipo Street
Onehunga S.E. 5, Auckland
Tel. 565-361

NORWAY
Morgenstierne & Co. A/S
Ingeniorfirma
6 Wessels Gatë, Oslo
Tel. 20 16 35

PAKISTAN
Mushko & Company, Ltd.
Oosman Chambers
Victoria Road
Karachi 3, West Pakistan
Tel. 54601

Mushko & Company, Ltd.
Zirat Chambers
31, Jinnah Avenue
Dacca, East Pakistan
Tel. 80058

PANAMA
Electronico Balboa, S.A.
P.O. Box 4929
Panama City
Tel. 3-0833

PERU
Fernando Ezeta B
Av. Petit Thouars 4719
Mira Flores, Lima
Tel. 5-0346

PORTUGAL
Telectra
Rua Rodrigo da Fonseca 103
P.O. Box 2531, Lisbon 1
Tel. 68 60 72

PUERTO RICO
San Juan Electronics, Inc.
Ponce de Leon No. 150, Stop 3
Pta. de Tierra Sta., San Juan
Tel. 725-3342

SPAIN
Ataio Ingenieros
Enrique Laretta 12
Madrid, 16
Tel. 235 43 44-5

SOUTH AFRICA
F.H. Flanter & Co. (Pty.), Ltd.
Rosella House
Buitencingle Street
Cape Town
Tel. 3-3817

F.H. Flanter & Co. (Pty.), Ltd.
P.O. Box 200, Bramley
775 Pretoria Main Road
Wynberg, Transvaal
Tel. 40-6871

SWEDEN
HP Instrument AB
Centralvagen 28
Solna Centrum
Tel. 08-83 08 30

HP Instrument AB
Box 4028
Indunagatan 28A
Molndal 4
Tel. 27 68 00

SWITZERLAND
Max Paul Frey
Wankdorffeldstrasse 66
Berne
Tel. (031) 42 00 78

TAIWAN
Hwa Sheng Electronic Co., Ltd.
P.O. Box 1558
21 Nanking West Road
Taipei
Tel. 46076, 45936

TURKEY
Telekom Engineering Bureau
P.O. Box 376 - Galata
Istanbul
Tel. 49 40 40

UNITED KINGDOM
Hewlett-Packard Ltd.
Dallas Road
Bedford, England
Tel. 68052

VENEZUELA
Citec, C.A.
Edif. Arisan–Of. No. 4
Avda. Francisco de Miranda
Chacaito
Caracas
Tel. 71.88.05

YUGOSLAVIA
Belram S.A.
83 Avenue des Mimosas
Brussels 15, Belgium
Tel. 35 29 58

For Sales and Service Assistance in Areas Not Listed Contact:

EUROPE
Hewlett-Packard, S.A.
54 Route des Acacias
Geneva, Switzerland
Tel. (022) 42.81.50

ELSEWHERE
Hewlett-Packard
1501 Page Mill Road
Palo Alto, California 94304, U.S.A.
Tel. (415) 326-7000

5 66

HEWLETT PACKARD hp DYMEC DIVISION 395 Page Mill Road, Palo Alto, California 94306

CERTIFICATION

The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.

WARRANTY AND ASSISTANCE

All Hewlett-Packard products are warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery, or, in the case of certain major components listed in the operating manual, for the specified period. We will repair or replace products which prove to be defective during the warranty period. No other warranty is expressed or implied. We are not liable for consequential damages.

For any assistance contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

HEWLETT
PACKARD
DYMEC
DIVISION

PRINTED IN U.S.A.